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SCIENCE 7

Module 2 Plants for Food and Fibre

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SCIENCE 7

Module 2

Plants for Food and Fibre

Learning Technologies Branch

Alberta LEARNING

Science 7
Module 2: Plants for Food and Fibre
Student Module Booklet
Learning Technologies Branch
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This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

You may find the following Internet sites useful:

- Alberta Learning, **http://www.learning.gov.ab.ca**
- Learning Technologies Branch, **http://www.learning.gov.ab.ca/ltb**
- Learning Resources Centre, **http://www.lrc.learning.gov.ab.ca**

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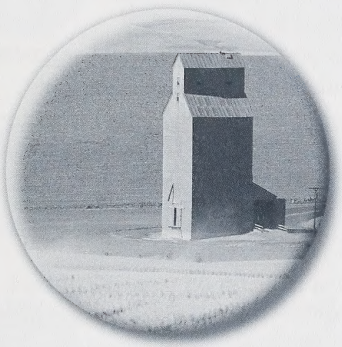

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Resources

Textbook

To complete the course, you need the textbook *ScienceFocus 7*.

Multimedia

Attached to Module 1 of this course is a CD titled *Science 7 Multimedia*. This CD contains multimedia segments designed to help you better understand particular concepts presented in this course. Ask your teacher or home instructor if you need help using this CD.

Materials and Apparatus

A list of materials and apparatus is given on page 10 of each Student Module Booklet. These items are needed to complete the module. Some of the materials and apparatus may be provided at your local school lab. If you don't have access to a school lab, you will need to get the loan kit. Talk to your teacher for more information.

Before You Begin

Organize your materials and work area before you begin: Student Module Booklet, textbook, notebook, pens, pencils, and so on. Make sure you have a quiet area in which to work, away from distractions.

Because response lines are not provided in the Student Module Booklet, you'll need a looseleaf binder or notebook to respond to questions and complete charts. It's important to keep your lined paper handy as you work through the material and to keep your responses together in a notebook or binder for review purposes later.

Refer to the Planning Ahead page for directions on what you need to do before you start this module.

Icons

This is one of five Student Module Booklets for Science 7. As you progress through this module, you will meet several icons.

Do Ahead

Some preparation must be started well ahead of the activity or investigation. For example, start the seedlings for the investigation in Lesson 3.

Teacher or Home Instructor

The teacher or home instructor should be contacted for help, approval of some procedure, or checking answers.

Assignment Booklet

Work needs to be done in one of the Assignment Booklets.

Safety

You must be very careful when you see this symbol.

Textbook

A reference is made to *ScienceFocus 7*, the textbook accompanying this course.

Internet

This is a reference to the Internet. **Note:** Any Internet website given is subject to change.

Multimedia

This is a reference to the *Science 7 Multimedia* CD.

Overview

Module 2 Plants for Food and Fibre

Section 1 Growing Plants

Section 2 Farming and Forestry

It's 7:00 A.M., and Halsey hears the alarm ringing. The smell of freshly toasted bread wafts into her room. It's enough to move her into the shower. Breathing citrus scent in deeply, she lathers her hair with a refreshing organic shampoo.

After wrapping herself in a fluffy towel, Halsey fixes her hair with the latest all-natural hair product. Opening her closet door, she decides on jeans and a T-shirt. Off to breakfast she goes. As usual, her dad insists she take an echinacea tablet.

Halsey has Grandma's homemade raspberry jam on her toast and wolfs it down with a large glass of orange juice. Now, with her stomach full, she races off to the bathroom to brush her teeth. It's now 7:50 A.M., and she's off!

Believe it or not, in this 50-minute scenario, plants and plant products were used at least ten times. Can you pick them out? You usually think of food as soon as you think of plants, but it goes a lot further than that. Plants help people breathe. They provide fabric for clothes; materials for paper, furniture, and buildings; and medicines. Plants and plant products are all around.

In this module you will look at some of the uses humans have for plants. You will see how people manage plant growth. You will learn how they select and breed plant varieties and how they change growing conditions to help crops thrive. You will then see how these techniques affect the larger environment.

Assessment

This booklet is the Student Module Booklet. It will show you, step by step, how to advance through Module 2: Plants for Food and Fibre.

This module, Plants for Food and Fibre, has two sections. Each section is built of lessons. Within the lessons, there are readings, investigations, activities, and questions for you to do. By completing these lessons, you will

- discover scientific concepts and skills
- develop a positive attitude toward science
- practise or apply these new concepts and skills

There are suggested answers in the Appendix of this Student Module Booklet. They provide you with a way to check your understanding. Your teacher will also provide you with feedback on your progress throughout the module.

At several points in this module, you will be directed to the accompanying Assignment Booklets. Your grading in this module is based on the assignments you submit for assessment. In this module you are expected to complete two section assignments and a final module assignment.

The mark distribution is as follows:

Assignment Booklet 2A	
Section 1 Assignment	55 marks
Assignment Booklet 2B	
Section 2 Assignment	44 marks
Final Module Assignment	46 marks
TOTAL	145 marks

Planning Ahead

Here is a list of materials and apparatus you will need to complete this module.

Section 1

- ❑ thumbtack
- ❑ graduated cylinder
- ❑ ruler
- ❑ thermometer
- ❑ mung bean seeds (or pea seeds or red kidney bean seeds)
- ❑ paper towel
- ❑ paper cups (or small pots)
- ❑ potting soil (or garden soil)
- ❑ water
- ❑ trowel (or small shovel)
- ❑ dandelion (with roots, leaves, stem, and flower)
- ❑ magnifying glass
- ❑ scissors
- ❑ blue food colouring
- ❑ carrot (with leaves intact)
- ❑ 250-mL beaker
- ❑ table knife
- ❑ scale
- ❑ 500-mL beaker
- ❑ celery stalk (with leaves)
- ❑ dried lima beans
- ❑ jar (or glass)
- ❑ large sheets of paper
- ❑ felt pens

Section 2

- ❑ thumbtack (or pushpin)
- ❑ potting soil (or garden soil)
- ❑ 4 trays (or saucers)
- ❑ scissors
- ❑ clear adhesive tape
- ❑ thermometer
- ❑ graduated cylinder
- ❑ ruler
- ❑ 4 coloured pencils
- ❑ 8 paper (or foam) drinking cups
- ❑ sprouted seeds
- ❑ 4 clear, plastic drinking cups
- ❑ water
- ❑ foam meat trays (or baking pans)
- ❑ organic material (e.g., wood shavings, grass clippings, leaves)
- ❑ paper towel
- ❑ spoon
- ❑ magnifying glass
- ❑ measuring cup (or graduated cylinder)
- ❑ 3 glasses (or 250-mL beakers)
- ❑ 3 small jars with screw lids (250–500 mL)
- ❑ 6 disposable cups
- ❑ labels
- ❑ 3 plastic lids (e.g., from a yogurt container)
- ❑ sand
- ❑ 3 cone-shaped coffee filters
- ❑ large sheets of paper
- ❑ felt markers

In Section 1: Lesson 1 you will need a package of mung bean seeds, pea seeds, or red kidney bean seeds. In Section 2: Lesson 1 you will need eight sprouted mung bean seeds to plant.

If you have access to the Internet, you may want to check out some of the links for this module ahead of time. Go to the following site:

http://www.mcgrawhill.ca/school/booksites/sciencefocus+7/student+resources/toc/index.php

Section 1

Growing Plants

If you have ever been in a desert, you know you wouldn't survive long in the hot sun. Sunglasses, a large hat, and a lot of water would help. However, there are many plants that call this environment home. They have adapted to this environment. Their structure and how they reproduce ensure their continued survival.

One of the common plants associated with a desert is the cactus. Cacti have all the parts of a typical seed plant—roots, stem, leaves, and flowers. Each is adapted to the hot, dry environment in which they function. For example, cacti have a large network of fine roots just below the surface of the sand. These absorb large quantities of water quickly. Inside the strong, waxy body of the cactus is a large area where water is stored. This helps the plant survive during long dry periods. The cactus has sharp needles that prevent animals from "stealing" the water. All these parts work together. It's how the cactus can survive in the harsh desert climate.

Like most animals, humans use cacti to meet their own needs and wants. In Arizona, Native Americans boil the flowers of the barrel cactus to make tea. Its hollow storage area can be used as a bowl. Aloe vera and other desert plants are used as medications or food.

In this section you will look at some uses humans have for plants—not just desert plants. The general structure of plants will be investigated. You will see a variety of plant adaptations. Then the needs of plants will be discussed. You will investigate how plants go about meeting their needs. Finally, you will increase your understanding of how plants reproduce.

Lesson 1: People and Plants

Imagine being in the middle of a corn field with your friends. At that moment you would think of plants simply as an environment for fun. Of course, plants have many other uses.

How do people use plants? The majority of people would say, "for food." Eating your vegetables and fruits is an important part of healthy living. Humans use plants for much more than just food. Plants play an important part in keeping the environment clean. They provide many different types of fibres used in everything from clothes to office towers. They are used for such things as transportation, fuel, construction, and medicine. In this lesson you will develop a better understanding of how human needs are met through plants. You will also develop an understanding of the needs of plants.

Read the "Preview" on pages 90 and 91 of the textbook. It gives a little background of how people use plants.

Going Further

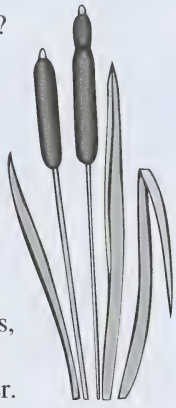
Are you looking for a challenge? Do you have or would you like to develop a green thumb? Read "Looking Ahead" on page 91 of the textbook.

Plants and the Environment

Imagine what your home, yard, and community would be like if people didn't clean up after themselves. Very unpleasant! Did you know that plants, in fact, do some of the clean-up for people? Plants are important to the health and cleanliness of the environment. This is only one of their many jobs.

DID YOU KNOW?

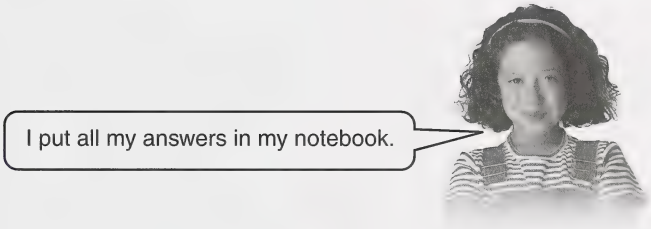
Do you remember studying the value of wetlands in Module 1?



The Edmonton International Airport produces a lot of run-off. They use a human-made wetland to treat it. Run-off is channelled into a holding pond. Then it's slowly filtered through a series of 12 small wetlands. De-icer and other chemicals are absorbed from the run-off by the cattails in the wetlands.

Natural wetlands attract birds and birds are hazardous to planes, so these wetlands needed very special planning. Deep, pebble beds (about 70 cm deep) overgrown with cattails hide the water. The cattails absorb toxic chemicals through their root systems. Birds are not attracted to the area. Both the birds and the airplanes are kept from any collisions.

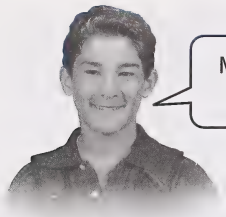
Turn to page 92 of the textbook. Read the introductory paragraph of "People and Plants" and "Plants in the Environment."



1. List five different ways plants help the environment.

Compare your response with the one in the Appendix, page 94.

Plants for Food



Mmm! Fruits, veggies, chocolates, and pop . . . just some of life's essentials!

Life's essentials! As if you couldn't do without them. More seriously, in the last module you saw that plants—where these goodies come from—are at the beginning of most food chains. This is because plants are producers. They make their own food. In fact, plants are a very large part of the human diet. Did you know that 75% of what people eat comes from seven major crops?

Read "Plants for Food" on page 92 of the textbook. Then answer the following question.

2. The teenager in the restaurant cartoon on page 92 is at a bit of a loss. He can only think of four things that come from plants: lettuce, onions, tomatoes, and pickles. Help him out! Challenge yourself by naming as many things in the picture as you can that are made from plants.

Compare your response with the one in the Appendix, page 94.

Cereal, fruit, the rest of the meal . . . Does it just land on the table in front of you?

Not really. It just shows up in the grocery store.

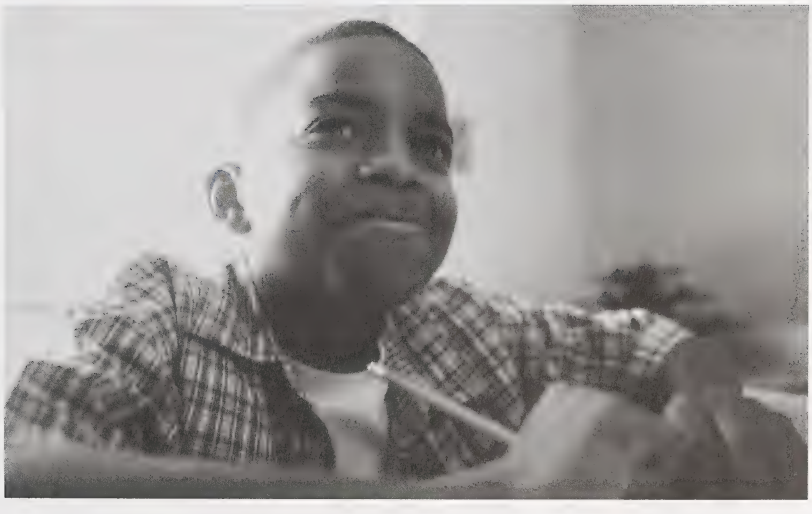
No, the food you eat doesn't just magically appear in the grocery store. There are many steps involved, like planting and growing seeds, harvesting, processing, packaging, storing, and transporting.

Read the first paragraph of "From Plant to Final Product" on page 93 of the textbook. Look closely at the pictures. Avoid reading the information below the pictures for now. The photographs in the first row show plants used in making certain food products (those in the second row). Try to match the plants in the first row with the food products in the second row. Check your answers by reading the information that follows the pictures.

3. Create a brief summary of the information in paragraphs A to D on page 93. Copy and complete the following table in your notebook. Plan the size of your table before you draw it.

Who Would Have Thought?		
Plant/Plant Part	**Food Product(s)**	**Processing Summary**
cocoa beans		
canola seeds		
seaweed		
sugar beets		

Compare your response with the one in the Appendix, page 94.



Getting Your Fibre

Have you ever chewed on a wooden Popsicle® stick or something like it? If you have a Popsicle® stick or a craft stick, give it a try. What does the texture feel like after a while? Did you say it was stringy, chewy, and tough? If so, what you are chewing is cellulose. The cell walls of plants are formed from cellulose, a material that most organisms find difficult to digest. This cellulose is, however, very useful to us as a source of fibre.

Throughout history, humans have used plant fibres. These plant fibres have been

- spun together to make many types of fabrics
- crushed and processed to make paper for writing, wrapping, and diapers
- cut up to build houses and furniture

Today, much of your clothing is made from synthetic fibres, such as polyester and Dacron™. There are, however, some important natural fibres that are still used.

Read "Plants for Fibre" on pages 94 and 95 of the textbook. You will find out more about natural fibres.

4. Write a definition of the term *fibre*.

Compare your response with the one in the Appendix, page 94.

Going Further

You may have seen or used decorative wrapping and writing paper made from recycled paper, flower petals, and leaves. The recipe for making your own paper is provided in "Investigation 2-A: Fibre Face-off" on pages 96 and 97 of the textbook. Have fun being creative!

Medicinal Plants

Mr. Casey: Have you ever had to put up with an upset stomach, a headache, or general pain?

Mikaila: I had the flu once.

Miguel: I sprained my finger playing basketball. When I tried to catch a pass, the ball pushed my finger back hard. It hurt so much that I dropped the ball.

Mr. Casey: Look at the pictures. They represent natural remedies. Tea from the prickly rose could help with upset stomachs. A special brew made from willow twigs may help with easing pain, like your sprained finger.

Herbal remedies made from plant parts and extracts (chemicals taken out of plants) have become a big part of North American popular culture. However, Aboriginal people have taken advantage of the natural healing powers of plants for centuries. For example, prickly rose tea was used to treat diarrhea. Willow twigs, now known to contain ASA (acetylsalicylic acid), were chewed or brewed as a painkiller.

Note: ASA is the active ingredient in Aspirin™.

Today, painkillers and other medicines can be manufactured. Science and technology have provided tools to analyze plant chemicals. They have also provided tools to make copies of these chemicals. ASA is an excellent example of this. Humans also have the tools to extract and purify chemicals directly from plants. A painkiller called morphine is an example of this.

For more information, read "Plants for Medicine" on pages 98 and 99 of the textbook.

5. Why is the opium poppy an essential plant?

6. Why is some natural quinine still used to treat malaria?

Compare your responses with those in the Appendix, page 94.

If properly used, some herbs can help you maintain your health or overcome ailments. You should be aware that herbs can have negative effects too. The benefits and harmful side effects of many herbs are still not known. As of 2003, there were few controls over quality, testing, or claims of effectiveness. For this reason, you should check with your doctor or pharmacist before using any herbal remedy.

Find Out Activity Herbal Remedies

Read the activity on page 99 of the textbook.

7. Complete question 1 of "Procedure" on page 99. Use a copy of the following table. Plan ahead so that the cells of the table are large enough for the information they will contain.

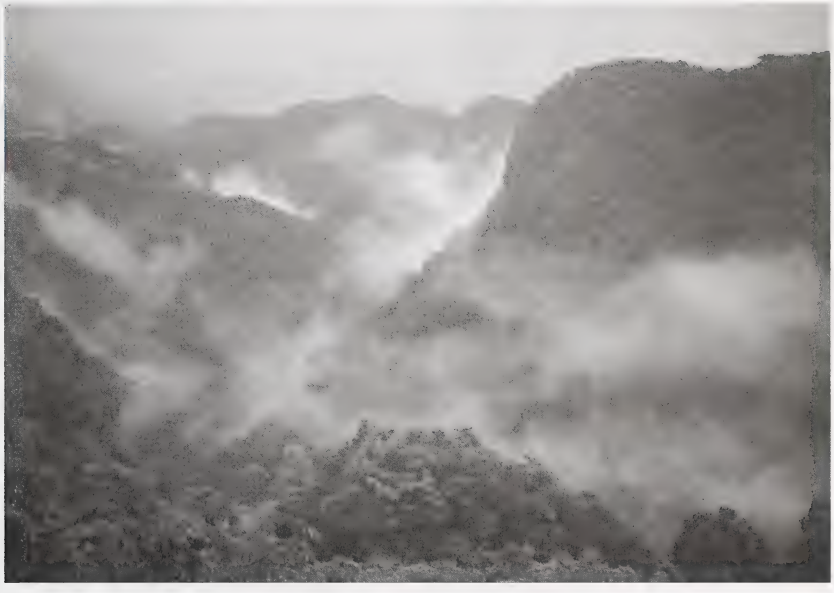
Medicinal Claims	
Herb	**Claims of Effectiveness**
echinacea	
feverfew	
garlic	
ginkgo biloba	
ginseng	
aloe vera	

8. Answer questions 1 and 2 of "What Did You Find Out?"

Compare your responses with those in the Appendix, page 95.

Going Further

If you are interested in a particular herb and would like to know more about it, do step 2 of the procedure of "Find Out Activity: Herbal Remedies" on page 99 of the textbook.



The tropical rain forests are a living resource. They are home to more than 50% of all plant species on Earth. Many of these plants are still unidentified and most have not been researched. Some may contain key chemicals that researchers are looking for.

As you have seen, many life-saving medicines come from plants. Many scientists work their whole life researching obscure plants. They hope one of them will be the key to a cure for a disease, such as cancer. Many of these plants come from endangered rain forests. There are many more plants to identify and check for useful ingredients.

Human needs and wants are endangering the rain forests of the world. People see the trees and rivers and want to use them. They imagine farms, mines, power plants, and sawmills. These would cause rapid destruction of the rain forest. Questions need to be asked: How important is keeping this natural resource? Can a balance be found? How much time is there before these vast ecosystems are lost? Will possible miracle cures remain unknown? This balance between nature and development will be discussed later in the module. You should start thinking about these issues now.

Plants for Transportation, Construction, and Fuel

Plants for transportation? That's strange, don't you think?

A canoe, a car, or even a horse I can see; but not plants. They're just stuck in the ground with roots.

Yeah, plants usually don't go anywhere.

Well, maybe the heading should read "Plant **Products** for Transportation, Construction, and Fuel."

You see, a canoe can be made with birch bark. A car can be lubricated with plant oils and fueled with alcohol—a product that can be made from corn. Actually, plants have been used for transportation throughout human history—from the wood used for boats to the natural-rubber tires originally used on cars.

Turn to pages 100 and 101 of the textbook. Read "Plants for Transportation and Construction" and "Plants for Fuel." You will find out more about the roles of plants in satisfying human needs and wants.

9. Name two liquid fuels that come from plants.

Compare your response with the one in the Appendix, page 95.

Being Needy

As you have seen, **people need plants**! Plants supply people with oxygen to breathe, food, fibres, and much more. But, **what do plants need**? People need to know this. If they shelter and support plants, the plants can continue to shelter and support them.

Pre-Investigation Preparation

Purchase a package of mung bean seeds, pea seeds, or red kidney bean seeds. Mung bean seeds are likely to produce the best results. They should be available at your local greenhouse or anywhere that sells seeds. You will also need several clear, plastic or glass cups and soil or paper towel.

You will be doing "Investigation 2-B: Growing Conditions for Healthy Plants." Four to five days ahead of time, soak at least 12 seeds for 24 hours. The actual number you require will depend on the procedure you develop. Each of your samples (including the control—if you have one) should have 3 to 5 seeds in it.

You will need to plant the soaked seeds and allow them to sprout before using them in your investigation. You could choose to plant the seeds between two paper towels or in soil. Soil that fills most of the cup works best. Place your growth medium (soil or paper towel) into your glasses. Moisten the growth medium by adding the same amount of water to each glass. Then poke holes and gently plant three to five soaked seeds close to the wall of each glass. This way, the root and stem growth can be easily observed and measured. Once your seeds have sprouted (a tiny plant appears), you are ready to do the investigation you have planned.

In the next activity you will look into what plants need in order to grow. You will be manipulating one variable to see how it affects the growth of a seedling. Before you start the activity, return to Section 2: Lesson 1 of Module 1. Review the investigative skills sections. Refer to this information regularly as you develop and summarize your investigation.

Turn to page 102 of the textbook. Read through this entire investigation. You need to choose a growth factor. You can choose one of the three growth factors suggested. You could also pick your own factor, such as the use of fertilizer. Pick a title for the investigation you will develop. Be sure to record your title in your notebook.

What factors might affect your experiment? Now is the time to think about these factors. For example, what type of seedlings are you going to grow? How many will you use in each sample? Where are you going to place the plants to grow? Are you going to move them around from day to day? Are you going to grow the plants in soil? How long are you going to grow them for? How can you measure their growth? These are just some of the things that might affect the results of your investigation.

10. Record your variables in your notebook. Use the format shown. Refer to Section 2: Lesson 1 of Module 1 for guidance. Remember, the variables must be stated as specific phrases, not as single words.

Variables:
MV:
RV:
CV:

11. Write a clear, scientifically testable question for your investigation.

12. Make a prediction about what you think will happen. It should be based on what you already know about the needs of plants. Record the hypothesis for your investigation in your notebook. Use the appropriate format. (As the MV _____, the RV _____ because _____.) Remember that your hypothesis needs an explanation section. It should add **new** information that is **relevant** to the prediction.

13. Plan the procedure you will use for your investigation. Refer to Section 2: Lesson 1 of Module 1 for guidance. **Remember:** As you write and review your plan, walk through the steps in your mind.

Check your responses with your teacher or home instructor.

Check your plan with your home instructor. Then perform your investigation. Carefully follow the procedure you developed.

Turn to page 1 of Assignment Booklet 2A and answer question 1.

14. Answer questions 2, 3, and 4 of "Evaluate" on page 102 of the textbook. Question 3 will apply only to the variable you tested.

15. Write a conclusion. Be sure you deal with these points:

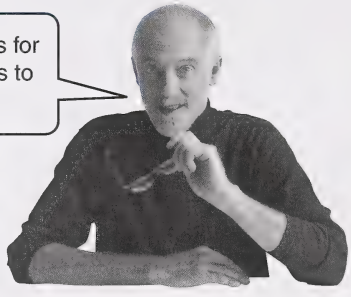
    - Give an answer to the question using your MV and RV.
    - Give all relevant conclusions coming from your data and analysis.
    - Does your conclusion agree with your hypothesis? If not, why?

Check your responses with your teacher or home instructor.

Turn to page 2 of Assignment Booklet 2A and answer question 2.

end of investigation

You have now completed the new concepts for this lesson. Answer the following questions to review what you have learned.



16. Answer questions 1, 3, and 8 of "Topic 1 Review" on page 103 of the textbook.

Compare your responses with those in the Appendix, page 95 and 96.

Looking Back

I bet you're thinking that plants are much more important to you than you used to think! They certainly touch almost every aspect of your life. You are probably realizing that you wouldn't even have a life without them!

After this introduction to plants, you are ready to move on to the next lesson. In the next lesson you will look at plant structures. You will see how these structures help a plant acquire its needs in its specific environment.

Turn to pages 2 and 3 of Assignment Booklet 2A and answer questions 3 to 6.

Lesson 2: Structures and Adaptations

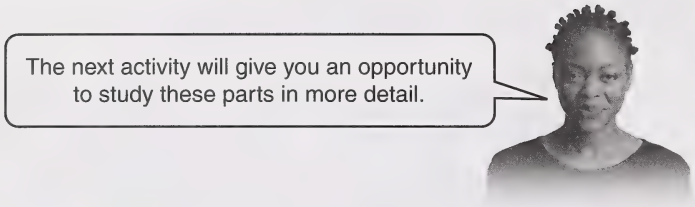
The cactus has adapted to survive in its harsh environment. The water plant on the right has adapted to its environment as well. It is obvious that these special adaptations are quite different. Still, don't be surprised to hear that these plants also have a lot in common.

In the first module you learned that plants form the base of most of the world's food chains. How do plants fit into so many niches? In this lesson you will focus on the plant structures that make this possible.

The Parts That Create the Whole

Just like any other living thing, plants need food to survive. Plants are very special, though; unlike the vast majority of organisms, they **make** their own food. They do this through a process called photosynthesis, which only requires sunlight, water, and carbon dioxide.

To build and maintain their bodies, plants must also obtain nutrients from their environment. But how does a plant get these nutrients? The answer is with different parts of the plant performing certain tasks. All plants have the same basic parts, although they may appear very different. Basic plant parts include the roots, stem, leaves, and reproductive structures.



Find Out Activity Digging into Dandelions

Read the entire activity on page 104 of the textbook.

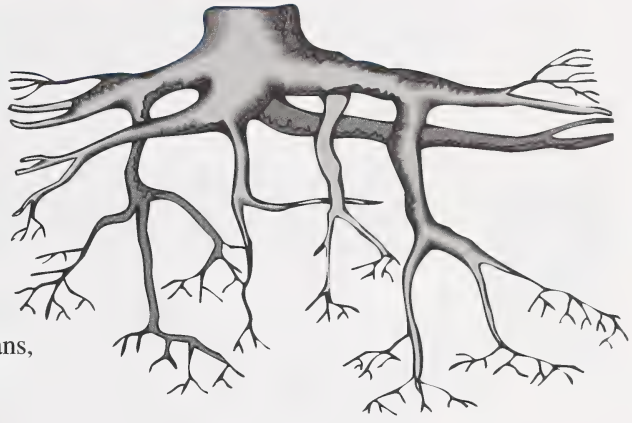
What if you cannot find a dandelion? Use another flowering plant. However, check with your teacher or home instructor before you dig anything up. Remember, you need the entire plant, including the roots.

1. Perform the activity. Then answer questions 1, 2, and 3 of "What Did You Find Out?"

Check your responses with your teacher or home instructor.

Getting to the Roots of the Matter

You don't generally think of kidneys, hearts, or lungs when you think of a person. Nor do you normally think of roots when you think of a plant. Plant organs—roots, stems, leaves, and reproductive parts—are as important to plants as kidneys, hearts, and lungs are to people. Like these organs, roots perform vital functions for the plant.



Turn to pages 105 and 106 of the textbook and read "Roots." You will find out more about these important structures.

2. Define the terms *taproot*, *fibrous roots*, and *root hairs*. Draw and label a sketch of a taproot and fibrous root. On each sketch, draw and label root hairs.

3. List the three main functions of roots.

4. Acid precipitation damages and kills root hairs. How would this affect plants?

Compare your responses with those in the Appendix, page 96.

Find Out Activity Getting to the Root of Roots

Read the entire activity on page 106 of the textbook.

Try to get a fresh carrot, parsnip (long, white), radish, or a small turnip with stems and leaves. If you cannot obtain a scale, estimate relative mass based on weight or size.

5. Perform the activity. Then answer questions 1, 2, and 3 of "What Did You Find Out?"

Compare your responses with those in the Appendix, page 97.

Diffusion and Osmosis

Nutrients and water need to get into the root, through the root, and into the stem. Extra food needs to be moved into the root for storage. The process by which water and dissolved substances get into, out of, and through the roots, stems, and leaves is called **diffusion**. When water diffuses, the process is given a special name—**osmosis**.

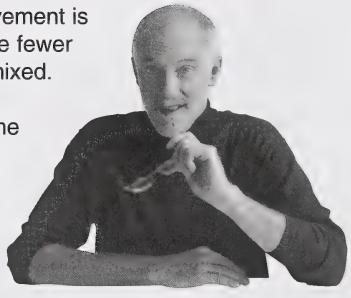
Read "Diffusion and Osmosis" on page 107 of the textbook. Examine each figure closely to gain a visual understanding of the terms. In Science 8, you will study these concepts in greater detail.

6. Define the terms *diffusion*, *differentially permeable*, and *osmosis*.

7. Fill a clear, colourless glass with water. Then drop two drops of food colouring into the glass. Observe what happens immediately, after 30 seconds, after 1 minute, and after 5 minutes. Explain what happened. Name the process you observed.

Compare your responses with those in the Appendix, page 97.

Holey Membranes



Mr. Casey: Diffusion is the movement of particles. The movement is from an area with lots of particles to an area where there are fewer particles. Diffusion continues until the particles are evenly mixed. The result is that there is no longer a region with high concentration or one with low concentration. Everything is the same.

Tara: You assume there is no barrier between the area of high concentration and low concentration.

Mr. Casey: Yes, without a barrier, the particles will move freely. But there can be a barrier as long as it has holes large enough to let particles go through.

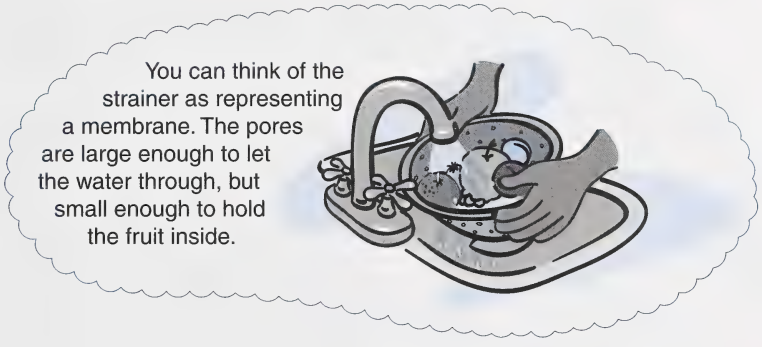
Tara: You mean the barrier has to be a like a strainer?

Mr. Casey: Well, sort of. But the holes may be miniscule—not even visible. You call such holes **pores**. Remember, the particles making up substances are miniscule themselves. So, as long as the pores are larger than the particles and there are lots of pores, the particles will get through the membrane.

Now, think about diffusion as it relates to plants. Plants need nutrients and water. Where are these substances? In the soil. How do they get into the plant? They get in by diffusion. Why would they diffuse into the plant's roots? Because there is more water and more nutrients in the soil (a higher concentration) than there is in the roots (a lower concentration). The water and nutrients will diffuse into the roots until the concentrations inside and outside are equal.

Cells are the basic building blocks of all living things. Each cell has a wall. The wall is a barrier with pores (holes). Some substances are small enough to get through these pores. Others are just too big to squeeze through.

Check out Figure 2.17B and Figure 2.17C on page 107 of the textbook. Those diagrams show a single plant cell magnified thousands of times. You see the diffusion of water into a cell. The special term *osmosis* is used for the diffusion of water.

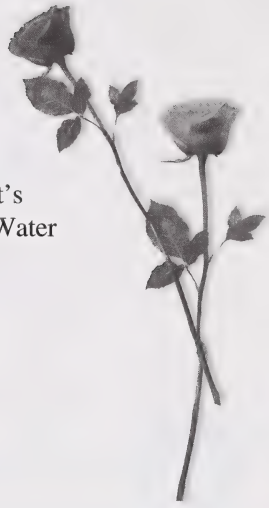

You can think of the strainer as representing a membrane. The pores are large enough to let the water through, but small enough to hold the fruit inside.

The cell walls and membranes allow some things in and keep other things out. They are said to be **differentially permeable**. The size of the pores in the barrier determines what can or can't get through. How do large particles that a plant needs get into the cells? A different process, called active transport, is used. Active transport is a more complicated procedure. It requires energy to pull the larger particles into the cell.

8. Why is the celery wilted in Figure 2.17B?

Compare your response with the one in the Appendix, page 97.

Stems



You now know that roots anchor, absorb, and transport. They have special shapes (e.g., taproots and fibrous roots) and structures (e.g., root hairs). Roots are adapted to perform the jobs they do in the circumstances they do them in. Now, it's time to move up in the world (or down, as the case may be). Water and nutrients that have made it into the plant's roots must be distributed for use throughout the plant. This job falls to the plant's elevators—the stems.

Read "Stems" on pages 108 and 109 of the textbook for more information.

9. List the three main functions of stems.

Compare your response with those in the Appendix, page 97.

Find Out Activity Celery Superhighway

How is celery like a superhighway? Read the entire activity on page 108 of the textbook.

This colourful activity gives you a great opportunity to see a stem structure in action! To achieve the best results, cut a fresh stalk from the base just before you move it into the coloured water. Pick a stalk with lots of healthy leaves. Cut all of the leaves off a second stalk and place it in the coloured water as well.

10. Follow the steps of the procedure carefully. Answer questions 1, 2, and 3 of "What Did You Find Out?"

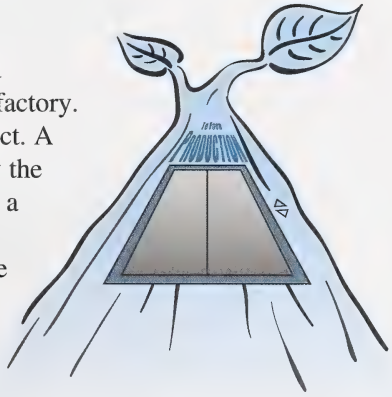
11. You saw what happened when the leafy stalk was left under a light. Suggest how your results might differ if the leafy stalk had been in a dark cupboard for 24 hours.

Compare your responses with those in the Appendix, pages 97 and 98.

Stem Summary

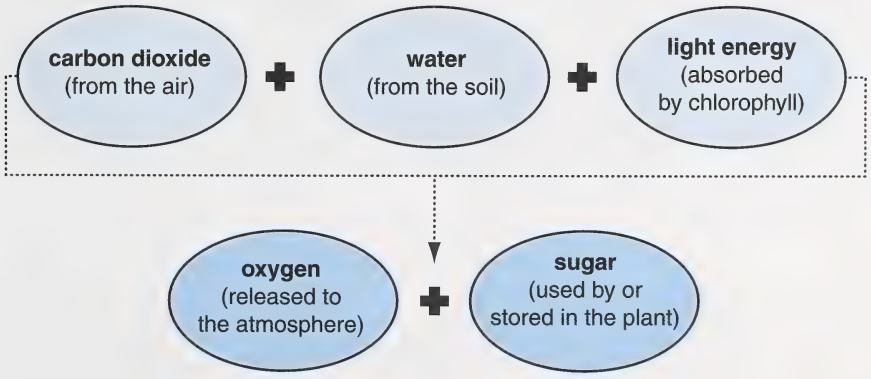
The three vital stem functions are storage, support, and transport. They require special structures. These special structures must be adapted to the plant's niche. Different environments and "lifestyles" place different demands on a plant's structures. Corms, bulbs, and tubers provide food storage. The food is used during periods of scarcity, like the spring growing season. Runners and rhizomes allow adult plants to assist young plants. They can supply food and water to young plants during their initial growing phase. The tube-like xylem and phloem tissues are specialized to transport essential materials up and down to areas of need throughout the plant. The next big question is, "What happens when it gets there?"

Green Factories

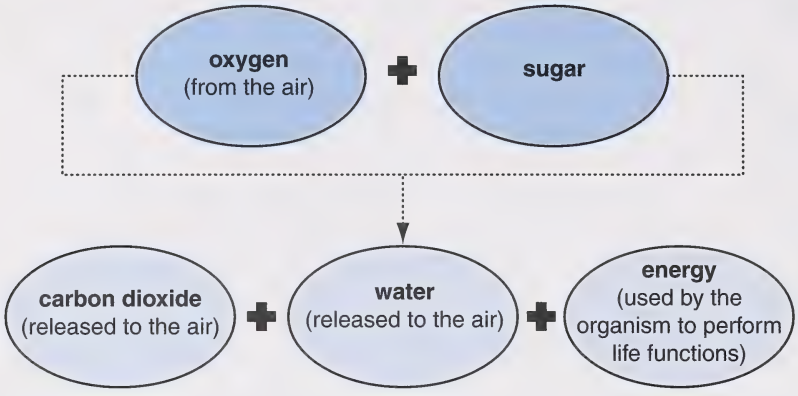


Stems act as the elevator, storage facilities, and support structure of plants. Leaves act as their factory. The main job of a factory is to produce a product. A plant's leaves produce food that can be used by the plant for energy. **Photosynthesis** is the process a plant uses to feed itself. In the leaves, energy from the Sun is used to combine carbon dioxide from the air with water brought up from the roots to make sugar. A green pigment, called **chlorophyll**, is used to absorb the light energy.

The following summarizes what happens during photosynthesis.



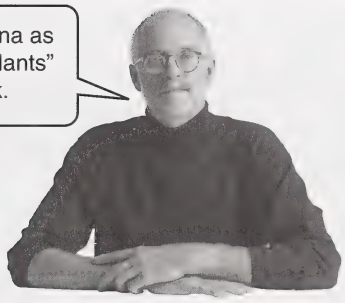
In the last module you were introduced to the next step—respiration. Respiration is the process in which sugar is broken down to release energy. This process is essentially the reverse of photosynthesis.



Remember that plants respire all the time. During the day, photosynthesis uses much more carbon dioxide than the plant produces. At the same time, it produces much more oxygen than the plant uses.

The celery activity showed you a second function of leaves. This function goes hand in hand with photosynthesis. The leafy celery stalk lifted far more water than the leafless stalk. This second leaf function is **transpiration**. It is how water exits from a plant. This helps pull water carrying nutrients up through the xylem tissue from the roots. Water entering the root hairs by osmosis helps push the water upward. Water can be pushed and pulled in a continuous column. That's because water particles are attracted to each other and to the walls of the tiny tubes in which it travels. As water evaporates from the leaves, more water is pulled and pushed upward to take its place. Stomata (tiny openings or pores) enable leaves to exchange water and other gases with the air.

Find out more about all of these phenomena as you read "Leaves" and "Moving Water in Plants" on pages 110 and 111 of the textbook.



12. Write definitions for the terms *chlorophyll*, *photosynthesis*, *respiration*, and *transpiration*.

13. Answer "Pause and Reflect" on page 110 of the textbook.

14. If you tie a plastic bag over a plant and its pot and leave it in a sunny spot for several hours, water droplets will begin to appear on the inside of the bag. What process could this be evidence of?

Compare your responses with those in the Appendix, page 98.

Going Further

Here's an activity that will allow you to design your own plant for profit or pleasure and create its habitat. Try the challenge in "Investigation 2-C: Design a Plant for Its Habitat" on page 112 of the textbook. If possible, have your friends, family, or home instructor participate in the activity with you. Modify the activity as necessary for your situation.

Research and find out more about the food and fibre plants raised in Alberta. Use the Internet or your local library. Refer to "Investigation 2-D: Food and Fibre Plants in Alberta" on page 113 of the textbook.

You have now completed the new concepts for this lesson. To review what you have covered, answer the next set of questions.

15. Answer questions 1, 2, 4, 5, 6, and 7 of "Topic 2 Review" on page 114 of the textbook.

Compare your responses with those in the Appendix, pages 98 and 99.

Looking Back

"Different but the same!" This could describe you and your friends, family, or neighbours. The same basic body parts are doing the same basic functions in the same way. But there are definitely differences between you and your family and neighbours. These differences give each person his or her own particular strengths, weaknesses, and appearance. The same can be said for plants.

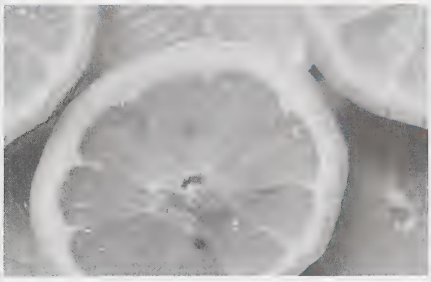
The basic structures of a plant are its roots, stems, leaves, and reproductive parts. They perform the same essential functions within each plant. Are these all the same in every plant? No, each plant has adapted to its environment and "lifestyle." For example, the dandelion is a very common plant in Alberta. A palm tree, on the other hand, is associated with the tropics. Why can't a palm tree survive in Alberta like the dandelion? It hasn't adapted its structures to live in Alberta.

Humans want to produce a bountiful harvest of strong, healthy plants. To do this, people need to understand plant structures and how they are adapted to the plant's niche. Then people can help alter structures or growing conditions to get the desired result. These are plants people can use to supply their own needs and wants.

What happens when plants are used up in meeting peoples' needs? Plant reproduction is the focus of the next lesson.

Turn to pages 3 to 7 of Assignment Booklet 2A and answer questions 7 to 12.

Lesson 3: Plant Reproduction and Breeding



North Americans eat a wide range of fresh fruits and vegetables. They expect them to be of excellent quality.

Companies spend a lot of money to develop better plants. Scientific research and technology is put to good use. The result is better plant products for the homes of North Americans.

Scientists have studied plant reproduction. They have found ways to control the reproductive process. They know what characteristics are needed. Technology lets them produce large numbers of these desirable plants.

Mr. Casey: We are used to getting good produce at the grocery store. In fact, shoppers are quite picky. Unless fruit and vegetables look perfect, they are left on the shelf. Some people even think that fruit with seeds is unacceptable.

Austin: Oh, I don't like oranges with seeds! Yuck! And seedy grapes too!

Tara: Yeah! But without seeds, how do you grow more seedless oranges or seedless grapes?

Mr. Casey: That is a good question, Tara. It is a question you will be able to answer easily once you know about the different ways plants can reproduce.

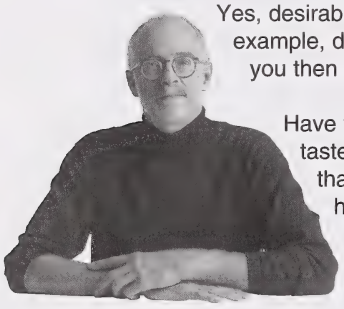
Over time, people have learned how to manipulate plants. People can make them increase yield or resist disease. Some may want them to be seedless and smell and look better. To grow plants with desirable characteristics, it is necessary to know how plants reproduce.

Tara: How would you define the term *desirable trait*?

Mr. Casey: When you have a meal, what do you look for? I know I want good taste and good nutrient value. The most important **traits** (or characteristics) relate to taste and energy content.

Tara: Oh, I see. After all, a tough, stringy texture might be considered great if you are going to use the plant to produce fibres for cloth or construction. But it may not taste great if you are planning to eat it.

Mr. Casey: Well, it would be a bit chewy.



Yes, desirability depends on the purpose you have in mind. For example, do you want a tomato that handles and stores well? Would you then accept a tomato that has less flavour?

Have you ever tasted a ripe tomato fresh out of the garden? It tastes different from one bought in a supermarket. It's not just that it's fresher. Different traits had to be developed so it would handle and store well. Mass production and distribution are different than growing a garden. Supermarkets want fruit and vegetables that last longer and resist damage. Suppliers **selectively breed** them to fit these traits.

Tara: So, why does this selective breeding affect taste?

Mr. Casey: There are often trade-offs. Sometimes, to get one thing you want, another one is lessened or lost. For example, a new drought-resistant grain is bred. It is less resistant to insects and diseases than the parent plants. As a result, farmers may have to spend more money to keep the pests away.

Turn to pages 115 and 116 of the textbook. Read the introductory paragraphs of "Topic 3: Plant Reproduction and Breeding" and "Across Canada." As you read, try to figure out what a desirable trait (or characteristic) is.

1. Define the terms *trait* and *selective breeding*.

2. Write your own definition for the term *desirable trait*.

Compare your responses with those in the Appendix, page 99.

Going Further

There are many varieties of apples in the produce section of a grocery store. Each variety has unique characteristics. This tasty bit of research has you sample and rate a variety of store-bought and home-grown apples.

Read "Find Out Activity: Apple Varieties" on page 116 of the textbook.

New Genes?

Nowadays, it's hard not to know something about jeans—or rather, genes. Selective breeding has been going on for thousands of years, and it's pretty much taken for granted. The newest wave in making new plants is **genetic modification** or genetic engineering.

All living things are made up of cells. Each cell contains blueprints for what the organism looks like, tastes like, smells like, and does. These chemically-coded blueprints are called **genes**. An organism's traits are tied to its genes. Scientists are starting to build up the whole picture. In many cases, they know that this trait comes from that gene. In the past, humans just selected organisms with desirable traits to serve as parents. They hoped that the desired characteristics would also be in the offspring. Now, scientists can directly alter the genetic content of a cell. They can even combine genes from different species to get a desired trait.

DID YOU KNOW?

Each human has about 100 000 genes. (Some recent estimates put this as low as 30 000.) They are packed into double helixes like that shown on the right. This chemical storage unit looks a lot like a spiral staircase. The spirals (DNA) store codes for physical and behavioural traits.

Why would anyone be concerned about changing genetic codings? Isn't that exactly what selective breeding does? For some, it's the unknown side effects that cause concern. For others, it's an unnatural tampering with the blueprints of life. People have very strong opinions on genetic modification. There is benefit and there is danger. How can the two be reconciled?

Turn to page 117 of the textbook. Read "New Genes?"

3. Write definitions for the terms *genes* and *genetic modification*.

Compare your response with the one in the Appendix, page 99.

Going Further

One of today's most controversial issues involving science and technology is genetic engineering or modification. To find out more about the fact and fiction behind the scientific and technical possibilities, try "Internet Connect" on page 117 of the textbook.

Types of Plant Reproduction

Like most organisms, plants can reproduce sexually. Many plants can also reproduce asexually. This is unusual for larger (macroscopic) organisms. **Sexual reproduction** is beneficial in that genes of two parents can be mixed together. The offspring have characteristics from both parents. This can lead to differences that help the offspring survive. Humans reproduce in this way. **Asexual reproduction** or **vegetative reproduction** involves only one parent. The offspring are identical to this parent.

Turn to page 118 of the textbook and read "Types of Plant Reproduction." You will find out more about vegetative (asexual) reproduction techniques used by plant growers.

4. a. What vegetative reproduction technique do trembling aspen clones use?

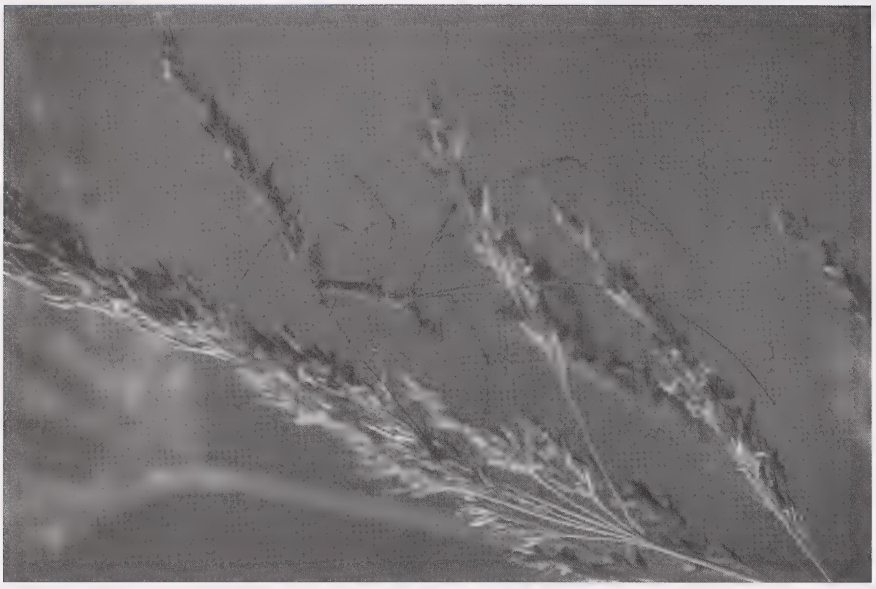
   b. How is it possible to tell if all of the trembling aspens in a particular woodlot are derived from the same parent plant?

5. What does grafting involve?

6. Navel oranges do not have seeds. All navel oranges are clones that come from a single mutant tree. Suggest how growers have been able to reproduce navel oranges in such large numbers.

Compare your responses with those in the Appendix, page 100.

Sexual Reproduction



Ms. Burton: Aren't these pretty flowers!

Miguel: Pretty, maybe. But flowers? I don't think so.

Ms. Burton: Yes, these are flowers. They contain the reproductive structures of the grass plants. You mean you haven't spent any time admiring grass flowers? Well, now that you know about them, you can start!

Miguel: Ha ha! Okay, but these grass flowers seem a little . . . well . . . drab. That is, next to tulips, gladiolas, roses, orchids, and so on.

Flowers can be drab or beautiful. All flowers contain the reproductive structures of their plant. Sexual reproduction forms a seed. The seed can grow into a new plant containing characteristics of both parents.

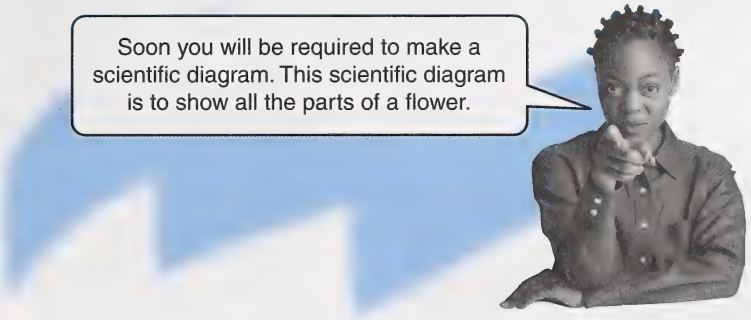
Turn to pages 120 to 123 of the textbook. Read "Seed Plant Reproduction" and "Off the Wall." You will learn more about seed plants. Then answer the following questions.

7. Define the terms *ovule* and *pollination*.

8. When you eat corn, what exactly are you eating?

Compare your responses with those in the Appendix, page 100.

Skill Development: Scientific and Technological Drawing



You generally communicate with words. But there is a saying, "A picture is worth a thousand words." This saying supports the idea that making diagrams and sketches is an important communication skill.

Turn to pages 482 and 483 of the textbook and read "Skill Focus 11: Scientific and Technological Drawing."

Note: Your diagram does not have to be as precise as the example in the textbook.

Scientific diagrams don't need to be a pretty, artistic, or creative. Rather, they should be simple, quick, and an accurate record of what you see. These diagrams should be

- as simple as possible
- two-dimensional
- clearly labelled
- titled
- neatly drawn (using a pencil and a ruler for straight lines)

The Parts of a Flower

Okay! Now it's time to look at the typical flower. Many flowers rely on animals to pollinate them. They **must** attract the animals. (For these flowers, no animals means no reproduction, which means no more of the plant.) This is why many flowers are showy, smelly, or tasty.

How can a flower lure its animal helper to it? It can present a visual display. (It looks good.) It can have a strong odour. (It smells good.) It can reward the animal with sweet nectar. (It tastes good.) The types of insects, animals, and birds attracted depends on the methods used. The way flowers are shaped and when they appear is adapted to "fit" the animal or animals that pollinate them.

Turn to page 122 of the textbook. Review "Parts of a Flower." You'll get the specifics on the reproductive structures of the typical seed plant.

9. Draw a diagram of the female parts of a flower. Show and label the **stigma**, **style**, and **ovary**. Follow all the guidelines given on pages 482 and 483 of the textbook.

Compare your response with the one in the Appendix, page 100.

Going Further

How do the reproductive structures of flowers vary? Try a plant operation to find out.

Obtain several different kinds of flowers, a magnifying glass, and a thin knife. Carefully sketch and label the details of each flower. You may wish to follow the steps in the "Find Out Activity: The Role of the Flower" on page 123 of the textbook. With your home instructor's supervision, dissect and sketch one flower at a time. Refer to the plant reproductive structure diagrams on pages 120 to 124 of the textbook. Note the differences and similarities among the reproductive structures. Consider how they are adapted to the way they are pollinated. For those that are likely pollinated by animals, what kind of structures must the animals have to "fit" the flower you are examining?

Pollination

Pollination is a process. In flowering plants, the pollen grains must be transferred to the female ovule. There are different ways pollination can take place:

- self-pollination
- cross-pollination by
  - wind
  - water
  - animals
- artificial pollination by people

Turn to page 124 of the textbook and read "Pollination." You will learn about pollination and its part in producing seeds.

10. What are self-pollination and cross-pollination?

11. When might artificial pollination be useful to plant breeders?

Compare your responses with those in the Appendix, page 100.

Seeds and Fruits

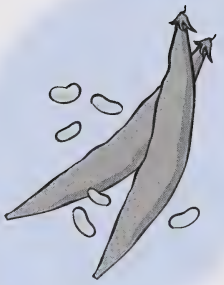
Ms. Burton: Do you remember being told to eat the green beans on your plate?

Miguel: Yes. I used to leave the beans for last. My big sister would say, "Vegetables are good for you." But I still wouldn't eat them if I knew I could get away with it.

Ms. Burton: Would it have helped you to know that beans are fruit?

Miguel: Fruit? That can't be!

Ms. Burton: According to plant science, beans are fruit. Let's see why.



Once a bean flower is pollinated, bean seeds form. As bean seeds develop, the ovary swells into a bean pod around these seeds. This protects them until the seeds are mature. Technically speaking, seeds along with the ovary are **fruit**.

fruit: the ripened ovary of a seed plant and its contents

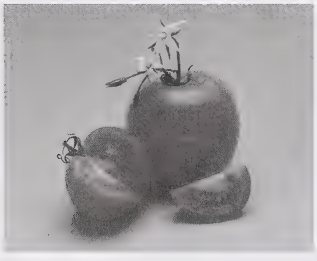
Still not convinced? Turn to page 125 of the textbook. Read "From Seed to Fruit" and "Fruit."

12. Figure 2.36 shows what the inside of the seed looks like. What three parts make up an **embryo**?

13. Why would the cotyledon be important to the embryo?

14. a. What is the name for the growing ovary that protects a developing seed?

    b. What is the scientific classification for these plant parts?

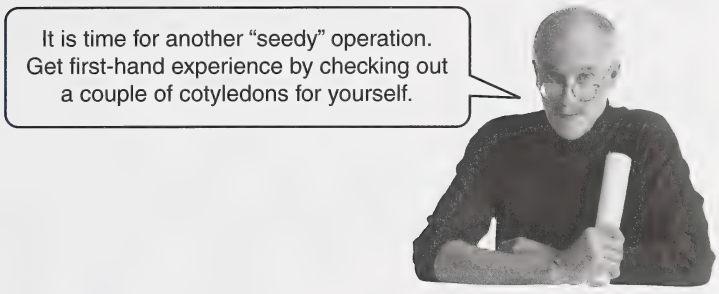


    c. Explain why you chose this classification.

Compare your responses with those in the Appendix, page 100.

Going Further

Is all this talk of about juicy, delicious fruits making you hungry? "Find Out Activity: Classifying Fruits" on page 126 of the textbook will give you a chance to dissect fruit and eat it too! Give this operation a try!



Find Out Activity Inside Seeds

Read the entire activity on page 125 of the textbook.

Follow the instructions in the procedure carefully.

15. Answer questions 1 and 2 of "What Did You Find Out?"

Compare your responses with those in the Appendix, page 101.

Spreading Seeds

Do these pictures look like something that just arrived from outer space? Actually, they are special adaptations that help plants spread their seeds. The light and fluffy filaments on the left catch the wind and carry the attached seed away. The nasty hooks on the second tangle in an animal's fur. The seed can "hitch a ride."

Turn to page 127 of the textbook. Examine the pictures in "Seed Dispersal." You will discover some of the many ways that seeds can be spread.

16. How does seedless grape production differ from that of seedless navel oranges?

Compare your response with the one in the Appendix, page 101.

Technological Change

Times, techniques, and technologies have changed a great deal over the last hundred years or so. Turn to page 128 of the textbook. Read "Spreading and Harvesting Seeds in the Field." It gives a brief glimpse at changes in seed dispersal and collection by humans.

17. List the two steps involved in the harvesting and separation of seeds from the adult plant.

Compare your response with the one in the Appendix, page 101.

Germination

The seeds have been formed and dispersed. What's next? The next step in the lifestyle of a seed plant must wait for the environmental conditions to be favourable. **Germination** occurs when dormancy ends and a sprout begins to grow.

Turn to page 128 of the textbook. Read "Germination" and study Figure 2.39. In the following activity you will get the opportunity to see what conditions are necessary for a seed to germinate.

18. a. Classify the plant parts shown in the magnification in the second diagram of Figure 2.39.

    b. Why is it important that these grow early in a seedling's development?

19. a. Create a cycle concept map. It should show the development of a seed plant from seed to seedling and then to mature plant. Title the graphic "Life Cycle of a Seed Plant."

    b. Turn to page 130 of the textbook. Complete "Find Out Activity: Helping Plants Grow." Then answer questions 1 and 2 of "What Did You Find Out?"

Compare your responses with those in the Appendix, pages 101 and 102.

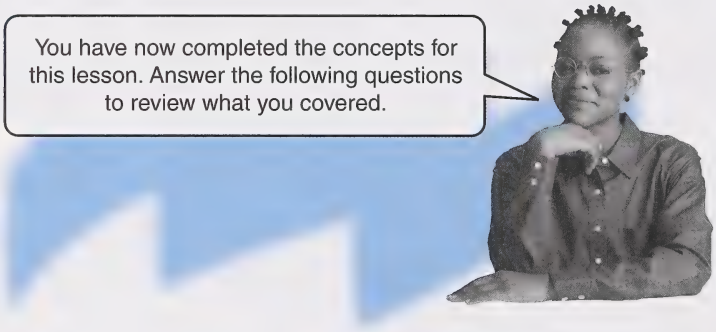
Going Further

Did you enjoy the "Growing Healthy Plants" investigation in Lesson 1 of this section? Try it again. Use any improvements in equipment or procedure, based on your newly acquired experience. Pick a different variable as a manipulated variable this time.

Be sure to ask show your plans for your investigations to your teacher or home instructor. Get approval before actually carrying out the steps of your procedure.

Refer to "Investigation 2-F: Speeding Up Germination" on page 129 of the textbook if necessary.

Follow the advice in "Looking Ahead" on page 130 of the textbook. The final project is drawing closer.



20. Answer questions 1 to 4 of "Topic 3 Review" on page 130 of the textbook.

Compare your responses with those in the Appendix, page 102.

Looking Back

Variety is indeed the spice of life! You are among the privileged people. You can share in a bounty of both natural and human-made variations. Do you dislike seeds in your oranges or grapes? If so, you can buy a different variety. If people get tired of the plants in their gardens, they can plant other varieties. Selective breeding of plants lets people create organisms that suit specific needs and wants. Who knows where the more recent and controversial science and technologies involved in genetic engineering will lead.

Creating variety requires knowledge. In this case, an understanding of plant structures, needs, reproduction, and growth is needed. Humans use both sexual and asexual plant reproduction to mass-produce healthy plants. It helps meet human needs for both food and fibre.

Turn to pages 7 and 8 of Assignment Booklet 2A and answer questions 13, 14, and 15.

Section 1 Review

1. Answer the following questions from "Wrap-up: Topics 1–3" on page 131 of the textbook.

   a. questions 1 and 3 of "Reviewing Key Terms"

   b. questions 4, 5, 6, 7, and 9 of "Understanding Key Concepts"

2. List the three stages in a seed plant's life cycle. Give a brief explanation of each stage.

3. Name the two main sexual reproduction structures that are shared by flowers and cones.

4. Why can a seed survive so long without the process of photosynthesis?

Check your responses with your teacher or home instructor.

Conclusion

In this section you looked at a variety of ways humans use plants. The variety of ways plants and their products can be used is marvelous. You investigated the general structure of plants and surveyed a variety of plant adaptations. You also found out more about plant reproduction.

You can be a survivor almost anywhere as long as there are plants nearby. The desert cactus, hardly a huggable plant, is still a friend to anyone stranded in the desert. This plant can provide food and water. It's stored just beneath its prickly exterior.

Turn to page 9 of Assignment Booklet 2A and answer questions 16 and 17.

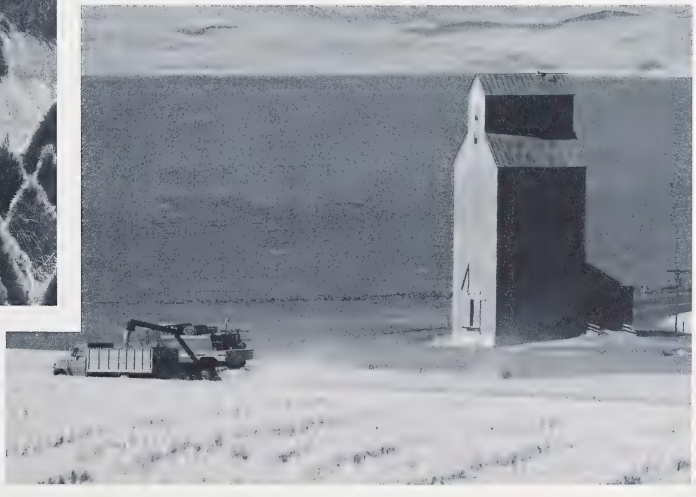
Section 2

Farming and Forestry

One of the pleasant things to do on a long trip is to watch the scenery go by. Maybe you remember some of the scenery from your travels—mountains, forests, lakes, trees, farmland, and so on. Maybe you were impressed by the amount of land used to grow crops. But then, most of Canada's farmland is in Western Canada. Alberta contains almost a third of Canada's farmland. So, it really is not surprising that you see lots of land under cultivation in Alberta.

Farmland is used to grow plants for food and fibre. But, not all plant products come from farmland. Forest lands are also important. Forest lands supply much of the plant fibre for human needs.

In this section you will study food and fibre products grown in Canada. You will look closely at those grown in Alberta today. You will also look at the work of agriculturalists and foresters. You will see how they use different practices and technologies to increase the yield of plants. You will study how these practices and the environment have changed over time. Later, different soil types will be investigated, as well as ways to improve the soil. Finally, ways to manage the problems of pests and the outcomes of these strategies will be examined.



Lesson 1: Meeting the Need for Food and Fibre

If you have ever played Jenga™, you know it is a challenging game. The goal is to build a high tower using a limited number of blocks. To increase the height, you must take a piece from the lower part of the tower and add it to the top. It is important to plan carefully. Removing the wrong piece may make the tower fall over. Repeated small changes or single, large changes may weaken the base, causing the tower to collapse. There are also times when even a well-planned move can create unpredicted changes.

Agriculture and forestry practices use the same basic principles. There is a high and growing demand for plant products. To meet the demand, new technologies are developed. They make production easier and maximize yield. The result is like making changes to your Jenga™ tower. With Jenga™, the tower becomes more and more unstable. In this case, it's the environment that becomes unstable. You will see the quality of the environment decline.

Turn to pages 132 and 133 of the textbook. Read the introductory paragraphs of "Topic 4: Meeting the Need for Food and Fibre" and "Agriculture in Alberta." You will get an introduction to the stresses that plant production can place on the environment.

1. Most people see a need to promote the health of natural systems. What two major approaches are scientists, farmers, and foresters using?

2. Of the 60 million hectares of land area in Alberta, how much is now managed as farmland?

Compare your responses with those in the Appendix, page 103.

Crops in Alberta

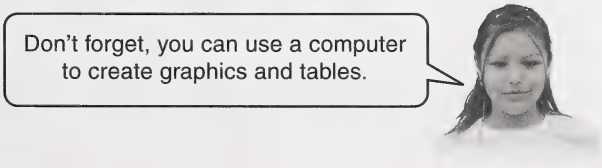
Farming is a large part of Alberta's economy. A patchwork quilt of fields is a common sight here. Refer to pages 88 and 89 of the textbook. You will see a satellite view of an agricultural region around Lake McGregor in Southern Alberta.

Turn to pages 134 and 135 of the textbook. You'll find an introduction to Alberta's major agricultural **monocultures**. Some you may have seen often; others you may not be familiar with.

3. What do you think a monoculture is?

4. In your notebook, make a table like the one given. Complete the table using the information from the textbook. Plan the sizes of the cells so they will hold the data comfortably.

Common Alberta Monocultures		
Crop Type	**Region of Province Monoculture Is Found**	**Uses/Interesting Facts**
Barley	**grown throughout the province (especially in drier areas)**	



5. Field corn can now be grown in central Alberta. What have plant breeders done to allow this? (**Hint:** Refer to "Did You Know?" on page 133 of the textbook.)

Compare your responses with those in the Appendix, page 103 and 104.

A barbeque in the summer is a real treat, right? Garden-fresh vegetables and fruits, like lettuce, potatoes, and strawberries, add to the experience.

Wheat, canola, and barley are the most common crops grown in Alberta. Fruit and vegetable crops are also important. You now get to find out more about them while practising your math and graphing skills.

Note: The definition of *hectare* (ha) is given in the "Did You Know?" box.

Find Out Activity Fruit and Vegetable Crops

Read the entire activity on page 136 of the textbook. Read the introduction and examine the bar graph carefully.

6. Answer question 4 of "Extension."

Check your response with your teacher or home instructor.

Growing in Glass Houses

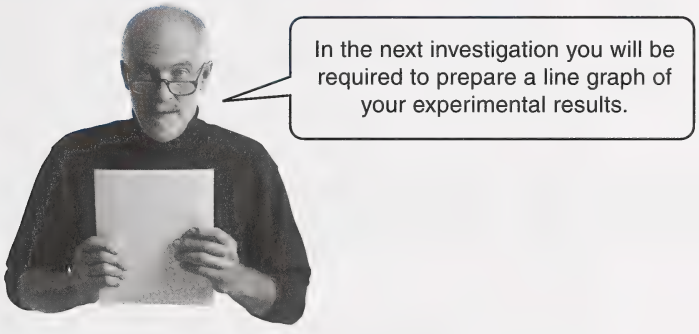
Have you ever visited a greenhouse? If so, did you find it had a warm, moist, and fragrant atmosphere? It is usually very different from the outside environment. Growers use greenhouses to control the growing conditions.

Turn to page 137 of the textbook. First, read "Growing Under Glass." Then read "Across Canada." The second article is about The Honourable Lois E. Hole, Lieutenant Governor of Alberta.

7. What growing conditions can be controlled in a greenhouse?

Compare your response with the one in the Appendix, page 104.

Skill Development—Line Graphs



First, read "Graphing Terms You Need to Know" on page 476 of the textbook. Then read and follow the steps of "Drawing a Line Graph by Hand" on pages 476 and 477 of the textbook.

8. Do "Instant Practice" on page 477.

Check your response with your teacher or home instructor.

For the next investigation you will need eight sprouted seeds. Germinate the seeds for at least four days in advance of this investigation. Any bean seeds may be used; however, mung beans would be the best. To ensure eight successfully sprouted seeds, it is a good idea to germinate ten or more seeds. Select the healthiest eight for the experiment.

You will also need some simple materials from around home. It's time to be creative. You will be making your own artificial environment to grow plants.

Investigation 2-G Greenhouse Growing Conditions

Turn to pages 138 and 139 of the textbook. Read the entire investigation.

9. a. Rewrite the question of the investigation. Use your own specific, manipulated variable (MV) and responding variable (RV).

   b. Write a hypothesis using your chosen MV and RV. (If you're not sure, check with your teacher or home instructor.)

   c. Follow the steps of "Procedure." Have your home instructor cut the pop bottles for you. Record your measurements in a data table for at least five days. Your table should include space to record air temperature, soil temperature, and the height of the plant. You need room for the four environments over a period of five or six days. Consult your teacher or home instructor if you have problems developing a data table on your own. Your line graph must meet all appropriate standards.

   d. Answer questions 1 to 4 of "Analyze" on page 139 of the textbook.

   e. Answer questions 5 and 6 of "Conclude and Apply" on page 139 of the textbook.

Check your responses with your teacher or home instructor.

end of investigation

Changing Practices

A hundred years ago you could have been doing the things shown above. Most of the people in Alberta lived on farms or in small agricultural communities. You may have heard your grandfather say that a lot of work was done manually rather than by powered machines. Things have changed, haven't they!

By the 1950s, almost all farming practices were more mechanized. Since then, farming technologies and practices have changed even more. Fewer farmers now work larger portions of land. Life has become urbanized for the majority of people.

Turn to pages 140 and 141 of the textbook. Read "Farming Practices" and "Farming Then and Now." They give a brief history of changes in farming practices.

10. Define the terms *irrigation* and *erosion*.

11. a. How is growing a monoculture efficient?

    b. Suggest a problem monocultures could create.

Compare your responses with those in the Appendix, page 104.

Farming practices are always changing. Since farming is a business as well as a lifestyle, farmers look for ways to increase the yield of their crops. They consider the basic needs of their plants. Think back to the first part of this module. Seedlings needed sufficient moisture, light, warmth, and nutrients to develop into healthy adult plants. Irrigation is used to grow crops in dry parts of Alberta. There is too little water during the growing season otherwise. However, irrigation must be managed carefully. Plants can drown in wet soil, or a buildup of dissolved salts can destroy the soil.

Turn to page 142 of the textbook and read "Saving Soil Moisture." You will learn more about irrigation.

12. What basic need of a plant is met with irrigation?

Compare your response with the one in the Appendix, page 104.

You use protection to keep water out. Soil needs care and protection to keep water in. Putting moisture into the soil artificially with irrigation can be very useful. In most areas, it is more important to make full use of the water nature provides. Soil containing lots of organic matter will absorb and hold moisture well. Compacted (squeezed together) or sandy soil holds less. In the next activity you will examine another factor—ground cover. Ground cover also affects the water content of the soil.

Find Out Activity Maintaining Moisture

Read the entire activity on page 142 of the textbook.

Follow the instructions in the procedure carefully.

13. Answer questions 1, 2, and 3 of "What Did You Find Out?"

Compare your responses with those in the Appendix, page 104.

Forestry in Alberta

Can you imagine your life without trees? No wood for housing, furniture, or paper. No woodlots or forests to wander through, camp in, or admire! Trees are clearly essential to life.

As a living resource, trees must be protected. Cutting trees for fibre products doesn't have to be a bad thing. Just do it carefully and properly reforest the area. The demand for forest products is increasing. The forests must be managed well for future use.

Human wants and needs must be balanced with the needs of organisms in the natural environment. Good **environmental management** is needed.

Human actions have both short- and long-term environmental effects. It is important that everyone looks at the effects of human actions. Science, technology, and experience provide people with choices. Making proper choices will help maintain forests over the long term.

Turn to page 143 of the textbook. Read "Fibre Plants and the Forestry Industry." You will learn more about the effect of human activity on forests.

14. Write definitions for the terms *environmental management* and *diversity*.

Compare your response with the one in the Appendix, page 104.

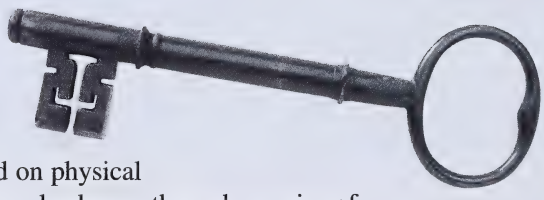
Six major tree species in Alberta are valued for lumber and paper. Pages 144 and 145 of the textbook give their descriptions. You may recognize some of them. You used a classification key based on them earlier. Now, it's time to study the diagrams and read the information.

15. Identify the tree species in the following table.

Species of Tree	Description
	good for wood panel products and often used for pulp and paper
	heavy, strong wood used for firewood and making furniture
	light, strong wood used for lumber and pulp; makes strong paper
	takes over from aspen and pine trees as a forest matures; used for lumber and plywood
	highly valued, strong wood used historically to build shelters and the railway
	resists fungi, making it useful for fence posts and railway ties

Compare your response with the one in the Appendix, page 105.

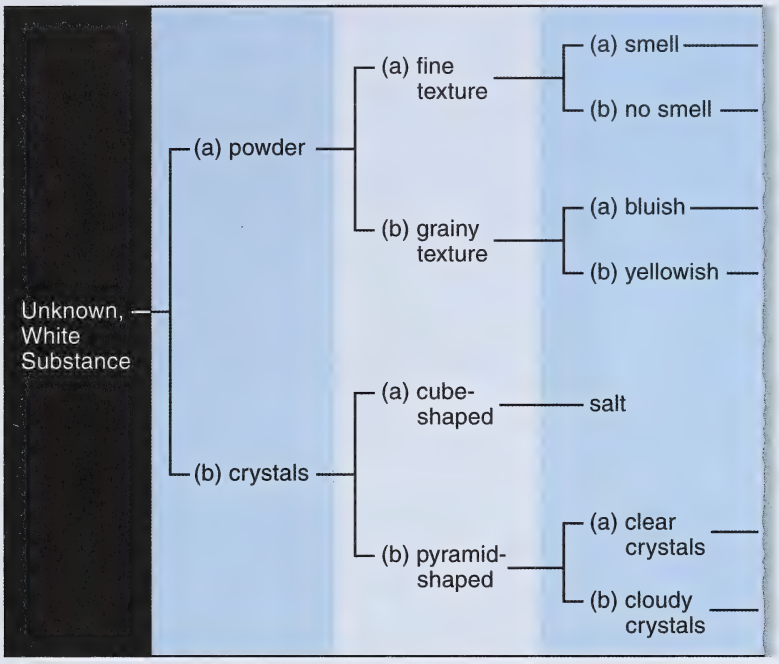
Find Out Activity — Using a Key to Identify Alberta's Six Most Valued Trees



You were introduced to classification keys in Module 1. Classification keys help you identify unknown organisms or objects. Keys provide a series of choices based on physical characteristics. A dichotomous key leads you through a series of true/false questions. At each step, your choice leads you forward. You get either another question or the name of the unknown organism.

You will now create your own dichotomous key. It should identify the trees shown on pages 144 and 145 of the textbook. Remember, each step has two branches. It breaks the current group into two groups based on an identifiable physical characteristic. Base your key on what you see and read on pages 144 and 145. After you have created your key, you will use it.

When planning your key, you may find it easier to start with a graphic model like this.



Refer to the classification key you examined in Module 1 if necessary.

16. a. Perform the procedure given in "Find Out Activity: Key It Out" on page 144 of the textbook. You'll be using the tree silhouettes, leaf diagrams, and tree information in the textbook. It may be easier to use more than two choices at some steps. Consult your teacher or home instructor as necessary.

    b. List the steps required to key out each of the six trees.

Check your responses with your teacher or home instructor.

Going Further

Turn to page 145 of the textbook. Try "Find Out Activity: Forest Products in Canada." You will find out more about the forestry industry in Alberta.

Deforestation and Reforestation

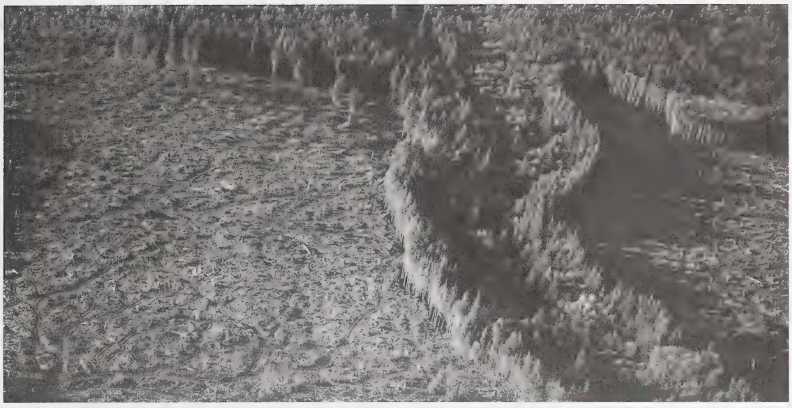
Planting tree seedlings is part of reforestation.

Forestry is an important industry in Canada. To remain important, our forests have to remain healthy. This living resource is essential to the forest industry. In the face of ever-increasing demands for wood products, proper environmental management is needed. Reforestation is an important part of good management. It ensures forested areas can be harvested over and over.

Sadly, reforestation usually produces a monoculture. The biological diversity of the natural ecosystem is lost. On the positive side, these reforested areas produce trees. Thus, fewer trees have to be taken from natural forests.

Government, loggers, and citizens all play a role in ensuring environmental sustainability. Before logging starts, they should find out if any long-term damage will occur. Here are some questions that should be asked:

- What changes will take place to prepare for logging? (e.g., roads and processing facilities must be built)
- Will the area be selectively logged or will the forest be totally removed?
- How will plants, animals, the soil, and the water systems be affected?
- What will the cumulative short- and long-term effects be?
- How can negative changes be minimized or reversed?



Read pages 146 and 147 and the top of page 148 of the textbook. You will get a general overview of deforestation, reforestation, and some of the problems involved.

17. List three global problems that are currently decreasing environmental health, diversity, and sustainability.

Compare your response with the one in the Appendix, page 105.

You have now completed the new concepts for this lesson. To help you check your understanding of these ideas, answer the following questions.

18. Answer questions 1, 2, and 3 of "Topic 4 Review" on page 148 of the textbook.

Compare your responses with those in the Appendix, page 105.

Going Further

How old do trees get? This is a good question! Answer it by trying "Internet Connect" on page 147 of the textbook.

Be a "Media Monitor." Make yourself more informed. But remember, you can't believe everything you read as you do "Find Out Activity: Media Monitor" on page 148 of the textbook.

Looking Back

You've now seen that balancing the needs of plants with your own wants and needs is very important. There is no easy solution. Knowledge, awareness, and long-term planning play a big part in making good decisions.

Agriculture and forestry are large parts of Alberta's economy. Both supply major amounts of food and fibre. Farmers are in their business for the long term. They need to control factors to keep having good crops for many years. Foresters would also like to harvest trees for pulp, paper, and other products far into the future. It is not just a matter of growing the biggest and best crop. Many factors affect the technologies and practices needed to give environmental sustainability.

Turn to pages 1 to 3 of Assignment Booklet 2B and answer questions 1 to 6.

Lesson 2: Sustaining the Soil

Do you see soil as a part of the natural environment? Without it, the world would be a very different place. Plants would have great difficulty growing. Soil supplies the nutrients necessary for growth and maintenance. The soil also stores vital air and water. Another important role of soil is providing anchorage for plants. It would be impossible for trees to grow tall or small plants to stand upright without soil. Just think what wind or moving water would do. In addition, the soil is also the home for multitudes of creatures, many of which help plants grow strong and healthy.

As you can see, soil is a very important natural resource. Humans are very dependent on plants, and plants are very dependent on the soil. Thus, people try to manage soil to keep it healthy and productive. There are positive and negative aspects to soil management. That is what you will look at in this lesson.

Soil Ingredients

The recipe for soil is quite simple, even though, in nature, it takes hundreds of years to make.

Soil Recipe

Ingredients:

- 1 cup weathered rock grains (mineral particles)
- 1 cup dead plant material (organic particles)
- hundreds of tiny spaces (pores)
- a multitude of tiny organisms (decomposers)

Directions:

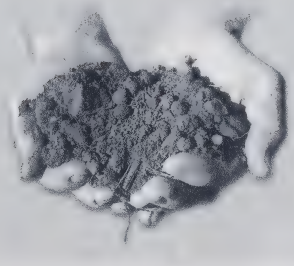
step 1: Rocks break down into tiny pieces (mineral particles). This may take hundreds of years.

step 2: Organic materials break down into small strips and chunks. (This dead plant and animal matter then becomes humus.)

step 3: Loosely mix about equal quantities of humus and rock particles together. Leave lots of pores within the soil. The amount of organic and mineral particles can be varied. The type of soil you create depends on the mixture.

step 4: Add a wide variety of decomposers and symbiotic bacteria.

step 5: Add healthy quantities of water over time.



The soil beneath your feet is a world in itself. Rock particles, **organic** particles, and pores all play an important part in creating soil. This process takes hundreds of years. The **parent material** needs time to break down and mix with decaying organic matter. As decomposers in the soil break down the **humus**, it releases nutrients important for plant growth.

Pores are the spaces between the particles. These spaces can be filled with life-giving air and water. Mixed throughout are the organisms upon which the plant relies for a continuing supply of nutrients. Soil organisms also provide the essential service of keeping the soil porous. This allows root growth and air and water storage.

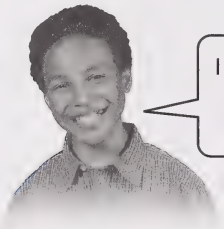
Turn to page 149 of the textbook and read the introductory paragraphs of "Sustaining the Soil."

The Dirt on Soil

The photograph of the hillside slump provides a window into the soil below your feet. This window is known as a soil profile. A soil profile shows the **horizons** (layers) in the soil from the surface to the bedrock. The ground below your feet is a hidden ecosystem that is a lifeline for millions of plants and animals. Soil is more than rock particles; it includes all the living things in it and the materials they break down.

The soil in your backyard differs greatly from the soil in Arizona or the soil in the rain forest. The basic components are the same. Rock particles, organic material, and pores make up all soil. The amounts and types of these three things cause a lot of variation in soil types.

Turn to page 150 of the textbook and read "How Do Soils Develop?"



I like to scan over the questions before I read so I know what to look for. It's also easier to do some of the questions as I go!

1. Write definitions for the terms *inorganic material*, *organic material*, *parent material*, and *humus*.

Compare your response with the one in the Appendix, page 105.

Common Soil Types

There are many types of soil. Here are three common soil types:

Sandy Soil: This is soil with lots of large pores between the coarse rock particles. Water runs through this soil quickly. Sandy soils don't stick together very well and plants have difficulty anchoring in it. There is little or no humus in this type of soil, so it doesn't have much food for plants.

Clay Soil: This soil is slippery when wet and clumps together when squeezed. It is composed of very fine mineral particles and very few organic particles. There are many very tiny pores in this soil that can hold water; but there is not much air in the spaces. Plants can drown in this type of soil when it is wet. It can also be very hard and difficult for plants to grow when it is dry.

Loam Soil: This is the perfect soil for plants and soil organisms. Its rock particles come in a mixture of sizes (very fine to very coarse). This soil has ample large and small pores for air and water. The humus content, nutrient content, and ability to hold water is high.

2. Define the terms *soil horizon* and *topsoil*.

3. a. Which of the three soil classifications would the topsoil in Diagram A of Figure 2.56 on page 150 of the textbook fit into?

   b. How would you classify the soil described in Diagram C of Figure 2.56 on page 150 of the textbook?

   c. Which soil type has the coarsest particles (grains)?

Compare your responses with those in the Appendix, page 106.

Soil Creatures

The gopher makes its home in the soil. In making its burrow, the gopher makes holes that let air and water enter the soil. Making holes in the soil is a service that is vital to plants. It also helps organisms that have a symbiotic relationship with plants and helps decomposers that break organic material down into plant nutrients.

Turn to page 151 of the textbook. Read "Soil: A Lively Community." You will be introduced to some other soil-friendly creatures.

4. How many tonnes of organic matter can the "intestines of the soil" process in one year?

Compare your response with the one in the Appendix, page 106.

Now's your chance to be a "Super Sleuth" or "Super Scientist." In the next investigation you will have the opportunity to closely examine, test, and classify different soils. You can get all the dirt on any soils you choose to lay your hands on. Good luck on your mission!

Investigation 2-H Soil Sleuth

Read through the entire investigation on pages 152 to 154 of the textbook before you start. This way you know what is required.

Now, perform the entire investigation.

5. Answer the following questions on page 154. Use all three of the soil classifications provided in this lesson, not just the two presented in the questions.

   a. questions 1 to 4 of "Analyze"

   b. question 6 of "Conclude"

Check your responses with your teacher or home instructor.

end of investigation

Nutrients for Plants

It is fairly obvious that not all soils are created equally. But now, you've got to ask, "Just what is it that plants get out of all that dirt?" Well, in one word, "nutrients."

Humus provides most of the nutrients that are necessary for plants. Sometimes, however, fertilizers need to be added. When plants grow in a field or garden year after year, they use up the nutrients in the soil. Some crops may also need more of a nutrient during part of the growing season.

Growers can use two main types of fertilizers for their plants. **Organic fertilizers** are all-natural. They come from decaying plant or animal matter, such as manure. **Chemical fertilizers** are human-made. They contain carefully controlled amounts of the three most essential nutrients.

Turn to page 155 of the textbook and read "All You Can Eat!" Also, read the introductory paragraph of "Find Out Activity: What's in the Bag?" You will find out how plant nutrients and fertilizers make strong and healthy plants.

6. Write definitions for the terms *organic fertilizer* and *chemical fertilizer*.

7. Gardeners use different fertilizer formulations at different times of the growing season. Suggest why they do this.

Compare your responses with those in the Appendix, page 106.

Going Further

At sometime during their lives, most people will own a houseplant or tend a garden. Knowing about fertilizers will surely come in handy. Do some up-close-and-personal research. It doesn't hurt to refer to books or the Internet too! Try the "Find Out Activity: What's in the Bag?" on page 155 of the textbook.

Soil Management—A Modern Necessity

As you have discovered, soil is much more than just dirt. It is a very valuable natural resource that needs to be looked after carefully. You would think irrigating and tilling soil would be a good idea. They are, but irrigating and tilling can create problems too. Are you surprised? Well, it's those unintended consequences again.

Turn to pages 156 and 157 of the textbook. Read "Challenges and Solutions" and "Organic Matter and Erosion."

8. Write a definition for the term *salinization*.

9. a. What two factors lead to salinization?

   b. What two things can be done to solve the problem of soil salinization?

10. Why is humus important to long-term soil preservation?

Compare your responses with those in the Appendix, page 106.

Going Further

Are you keeping the Unit 2 Project in mind as you work your way through the module? Turn to page 156 of the textbook. "Looking Ahead" suggests some experimentation that will help to keep you on track.

Soil Conservation

Folding fields of fertile soil. Poetic, isn't it? It's also a beautiful sight. Now, you have a greater appreciation of what goes into the soil. You've seen what goes on in the soil. You understand that it's a priceless medium that supports plant life. Without it, life would be very different. People need to take care of the soil that takes care of them.

Turn to pages 158 and 159 of the textbook and read "Saving the Soil."

11. How do good farming practices relate to the carbon cycle?

12. How do **shelterbelts** (rows of trees) help limit erosion?

Compare your responses with those in the Appendix, page 106.

Hydroponics

Hydroplane, hydrotherapy, hydrophilic, hydro-electricity, hydrophobic, and hydroponics—what do all of these terms have in common?

Let me think. Of course, they all start with *hydro*. When you hydroplane, you skim over water. Hydrotherapy is a therapy involving water. Hydro-electricity is power produced by water. All these words deal with something relating to water. *Hydro* must mean water.

That's right! What about *hydroponics*? Hydroponics is what this lesson is about. In fact, the trees shown in the photo are being grown hydroponically in a greenhouse.

Growers who produce crops hydroponically use water as their nutrient source, not soil. Hydroponics allows complete control of all environmental factors. As a result, crops grown hydroponically are of high quality and have a high yield. The down side is that hydroponics is very expensive; someone must watch it closely for it to work.

Turn to page 160 of the textbook. Read "Hydroponic Technology" to find out more about hydroponics.

13. Define the term *hydroponics*.

Compare your response with the one in the Appendix, page 106.

Turn to pages 176 and 177 in the textbook. Read "Ask an Expert." You will be introduced to a scientist who studies crop growth. This scientist will tell you more about hydroponics and other techniques used to grow greenhouse crops.

14. Are pests more likely to be a problem in greenhouses or fields?

Compare your response with the one in the Appendix, page 106.

Going Further

Go ahead! Try it! Yes, you can grow your own plants without all that messy soil. Just follow "Investigation 2-I: Construct a Hydroponic Garden" on page 161 of the textbook.

Planning has reached the final stages. It is time to get started on your unit project. Read the advice provided in "Looking Ahead" on page 162 of the textbook. Then read through the Unit 2 Project on pages 178 and 179 and get growing!

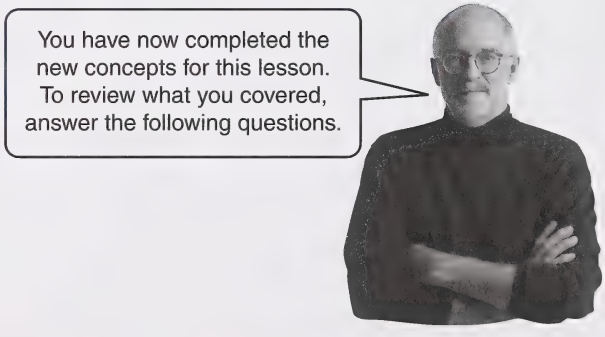
Forests Have Soil, Too!

Do you think that a forest affects the soil it grows in? Do you think that removing a forest would affect the soil it grew in? Study the picture. Do you think wind and water erosion are more or less likely to occur now? Will the amount of water absorbed into the soil change? How will soil temperature be affected by deforestation? Does our demand for wood fibre affect the soil?

Turn to page 162 of the textbook. Read the top of the page for the natural connection between soil, water, wind, erosion, and trees.

15. How can soil erosion due to deforestation be decreased?

Compare your response with the one in the Appendix, page 107.



16. Answer questions 1 to 6 of "Topic 5 Review" on page 162 of the textbook.

Compare your responses with those in the Appendix, pages 107 and 108.

Looking Back

Soil has mineral particles that have been formed from parent rock material. It has organic particles formed from decayed plant and animal material. As well, it has water and air held in pores. It's everywhere! You sweep it up, dump it out of your shoes, and wash it off your food and clothing.

Now, you know more about it. You know that soils differ. Their texture, particle size, and ability to hold water are different. They can have different amounts and types of organic and inorganic particles. Plants have adapted to different soil types. They take advantage of what is available to them.

You know that soil is brimming with multitudes of living things. They all help make healthy plant growth possible. Perhaps, most importantly, you know that soil is an important natural resource. It needs to be managed wisely to remain sustainable. Modern agricultural practices and technologies present a wide variety of choices. These should allow people to continue to grow plants for both food and fibre well into the future.

Turn to pages 3 to 5 of Assignment Booklet 2B and answer questions 7 to 12.

Lesson 3: Pests and Pest Control

What do you think of when you hear the word *pest*? Most likely, images of something or someone annoying you flash through your head. Maybe it's a mosquito; maybe it's a brother or sister. Either way, the point is simply that you may have lots of images that describe your meaning of the word *pest*.

When speaking of plants and their pests, the definition gets more technical. In this lesson you will examine some plant pests, pest controls, and the effects they may have. You will also look at safe strategies to control these harmful organisms.

Pest Profile

If you take a close look at a grasshopper, you do not see anything glamourous. To farmers, grasshoppers are pests. Pests are never a pretty sight.

Ask anyone who is trying to grow plants what a pest is. A **pest** is any living thing that keeps crop plants from growing well. Pests can come in all forms. They may be undesirable plants (weeds) or animals (such as birds, rodents, insects, and insect larva). Pests may even be microscopic organisms, such as fungi and bacteria. If any organism is not allowing a plant to grow to its full potential, it is considered a pest.

Strategies and technologies have been developed to control pests and limit their damage. Some of these technologies can control pests very well. That's why herbicides and pesticides are popular. However, they can have serious, unexpected, long-term, negative effects.

Getting mad at pests won't solve any of the problems they cause. That does not do much. Pests are just doing what it takes to survive. Farmers and foresters really get after pests—they spend millions each year to control them. This is mostly because monocultures, which farmers and foresters grow, actually help pests.

Turn to pages 163 and 164 of the textbook and read "What Is a Pest?" and "The Pest Problem."

1. Why is the grasshopper considered a pest?

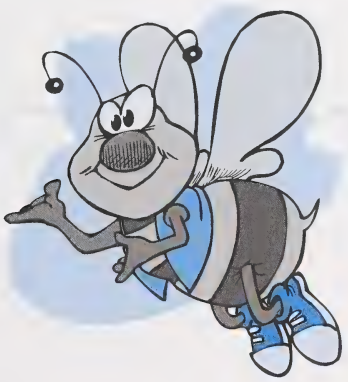
2. Why are monocultures excellent places for pests to live?

3. What percent of Canada's annual harvest do insects and diseases consume?

Compare your responses with those in the Appendix, page 108.

As you saw, pests are just trying to survive. They, too, need enough food, light, space, nutrients, and other things to survive. In the process, they are stealing these necessary items from the plants people are trying to grow. In a natural environment, like a forest, competition for basic needs is natural and balanced. It becomes a problem in a managed environment. People want their plants growing without competition.

Something is a pest only when it gets in the way of human goals and activities. For example, some people consider bees to be a pest. In fact, bees are essential to the seed production of many crops. They are often the unplanned victims of poisons used to control other insects.



Find Out Activity Friend or Foe?

Refer to the activity on the page 164 of the textbook. Read the introductory paragraph and the first step of procedure.

4. Copy the following table into your notebook or use a computer. Plan the size of the cells so the data will fit nicely. You will need at least five rows.

   Complete the table by interviewing people who have had experience growing plants or working with plants (agriculturists, greenhouse personnel, foresters, farmers, and gardeners). You can also do research at the library or on the Internet. An example has been provided to help you with your research.

Pest Research			
Source	**Pest Identified**	**Direct and/or Indirect Effect of Pest**	**Control Methods**
Dad	**cabbage butterfly**	**Larvae (caterpillars) of the cabbage butterfly eat the leaves of garden and crop plants.**	• **picking caterpillars off by hand for small areas** • **cleaning up debris and turning up the soil in the fall to expose to winter conditions** • **promoting populations of wasps that eat the caterpillars** • **using insecticides**

5. Answer question 1 of "What Did You Find Out?"

Check your responses with your teacher or home instructor.

An Example of a Perfect Pest

Some pests are adapted to a wide range of conditions and are very difficult to get rid of. Dandelions are a good example of a weed pest. They seem to keep growing no matter what control measure is taken.

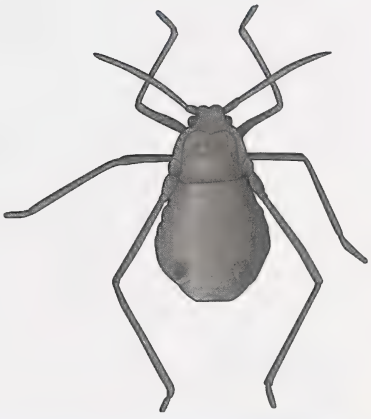
Turn to page 165 of the textbook. Read "Dandelions: Profile of a Champion Competitor."

6. List and summarize the five dandelion adaptations that make it such an effective pest.

Compare your response with the one in the Appendix, page 108.

Canola Pests

Different plants have different pests. As you studied earlier in this module, canola is one of Alberta's leading food crops. Canola has its own set of pests that farmers must work hard to control so their damage is kept to a minimum.



Turn to page 166 of the textbook. Read "Canola and Its Pests." It details how these pests can severely damage a prominent Alberta crop.

7. What new development is making it easier for farmers to control weeds in canola fields?

Compare your response with the one in the Appendix, page 108.

Introduced Species

In Module 1 you discovered that many species of plants and animals have been introduced to Canada by accident or on purpose. Many of them have become pests. In fact, some of the worst weed and insect pests came from Europe. To learn more about these immigrants, read "Introduced Species" on page 167 of the textbook.

8. What are three examples of introduced pests?

9. Provide an example of an organism introduced as a biological control that became a pest.

Compare your responses with those in the Appendix, page 108.

DID YOU KNOW?

Aspen trees have adapted to the ravages of tent caterpillars. They are able to complete the process of photosynthesis through their bark. This allows them to survive when their leaves are stripped off by massive waves of caterpillars. The tree produces a grainy white coat to cover its bark in the winter. This prevents unnecessary photosynthesis. Aboriginals used this powder as a sunscreen.

Controlling Pests

As long as there have been pests, people have tried to control them. The efforts to control or even eliminate pests have involved a wide variety of techniques.

Turn to page 168 of the textbook and read "Controlling Pests."

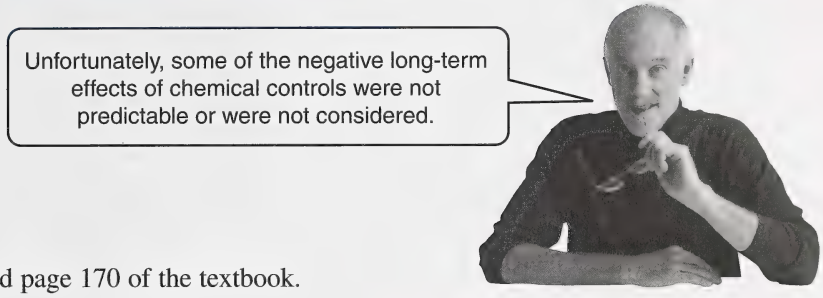
10. Create a point-form list of six major techniques humans have used to control pests.

Compare your response with the one in the Appendix, page 109.

Going Further

Get your family and friends together to "pass the poison." How many of them can stay alive in the fast-paced and educational game outlined in the "Find Out Activity: Passing on the Poison" on page 169 of the textbook?

A Storybook Ending?


Unfortunately, some of the negative long-term effects of chemical controls were not predictable or were not considered.

Read page 170 of the textbook.

11. Write definitions for the terms *herbicide*, *insecticide*, *pesticide*, and *residues*.

12. Explain why the pesticide you use today could affect your grandchildren's environment.

Check your responses with your teacher or home instructor.

Some Negative Affects of Chemical Pest Controls

Think about it! How long do pesticides remain in the air, water, and soil? What happens to the containers they are stored and shipped in? What chemicals are released as the residues break down? How much does anyone really know about the long-term results of using chemical pest controls?

Read page 171 of the textbook to find out about another negative aspect of chemical pest controls.

13. Write a definition for the term *resistant*.

Compare your response with the one in the Appendix, page 109.

DID YOU KNOW?

Some beautiful mountain lakes are really very polluted! Precipitation dumps in pollutants carried in the air from hundreds of kilometres away. Cold temperatures prevent the toxins from breaking down. The pollution build up in these lakes because more arrive all the time. The pollution levels can become so high that these lakes will no longer support aquatic life.

Pesticides, fungicides, insecticides, and herbicides are very dangerous chemicals. They need to be handled with care at all times. They also must be disposed of properly. In the next activity you will examine the labels on a chemical pest control.

Find Out Activity Pesticide Safety Labels

Refer to the activity on page 171 of the textbook.

You will need to examine the container for a pesticide safely. Ask your teacher or home instructor to help you locate a clean pesticide container. Maybe you can go on a field trip to a garden centre that sells pesticides.

14. Do the entire activity. Then answer "What Did You Find Out?" Use point form to record your answers.

Check your response with your teacher or home instructor.

Alternative Pest Control Methods

Imagine pests simply taking over the plants people try to grow. Instead of people being able to take in a harvest, the pests—beetles, mice, caterpillars, and so on—help themselves first. What would be left? Probably not much.

Many people are against the use of any chemical pesticides. However, good pest control is needed. Otherwise, pests would make growing enough food to feed the world's people impossible. Millions would die of starvation or from malnutrition.

Are there no alternatives to chemical pest controls? Can nothing be done to decrease the use of pesticides?

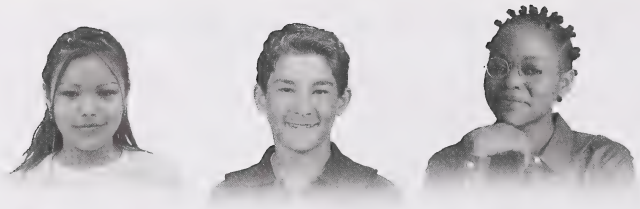
You know that knowledge and experience provide choices. For example, the Romans learned that the chemicals they used for killing pests were killing people instead. They quit using them. Luckily, modern science and technology lets pesticides be tested before they are widely used. People don't have to rely so heavily on personal experience or learning from mistakes. Older solutions can be improved. With proper management, people can keep up crop production without polluting the environment and poisoning people.

Turn to pages 172 to 174 of the textbook. Read "Organic Food Production," "Biological Control," and "Producers and Consumers—Partners in Sustainability."

Ms. Burton: Who determines how pests are controlled? The growers, government, concerned groups, and individuals all have a say.

An apple bought in a store will likely be covered with pesticide residues. What can you do to affect the use of pesticides on apples?

Tara: I could pay a bit more and buy organic.



Ms. Burton: Organic controls work best in small, easily managed areas. Unfortunately, modern monocultures are usually large operations. Also, organic produce is often less than "perfect." But buying organic does send a message to producers—don't use harmful pesticides.

Austin: It is nice to know that I can make a difference.

Ms. Burton: Yes. Consumers of food and fibre do play an important role in maintaining sustainability. Think critically about your wants and choices. You need to think about their long-term effects on the environment.

15. Foods produced organically are often more expensive. Would you be willing to pay extra for foods grown this way? Explain your answer.

Compare your response with the one in the Appendix, page 109.

Going Further

Go organic! Figure out a way to slay those slimy slugs in an all-natural way. Try "Find Out Activity: Controlling Slugs the Organic Way" on page 173 of the textbook.

You have now completed the new concepts for this lesson. For a review of what you covered, answer the following questions.

16. Complete questions 1 to 4 of "Topic 6 Review" on page 174 of the textbook.

Compare your responses with those in the Appendix, page 109.

Looking Back

What do you think of now when you hear the word *pest*? Has your idea of a pest broadened or changed? Plant pests certainly do come in a wide variety of shapes and sizes. They can be plants, animals, or microscopic organisms. They can "steal" what plants need for them to grow. They could also eat parts of the plants or infect the plant with a disease.

Traditional pest control includes hand picking pests, crop rotation, and cultivation. For the most part, chemical pest controls are a recent development. They are generally easy to apply and very effective. However, with time, some of their negative effects become easier to see: non-target organisms are often harmed and bioaccumulation becomes a problem. Negative effects can last for decades after the chemical is applied.

There are alternatives to chemical pesticides. Examples include organic farming, biological controls, and the four Rs. A sustainable, worldwide food and fibre supply doesn't mean an unhealthy environment. Scientific knowledge and technological know-how can help keep both. Consumers, producers, and governments working together will help find the needed balance.

Turn to pages 5 and 6 of Assignment Booklet 2B and answer questions 13 to 17.

Section 2 Review

Now, do the following "Wrap-up Topics 4–6" questions on page 175 of the textbook. These will help you review and apply the work in this section.

1. Answer question 2 of "Reviewing Key Terms."

2. Answer questions 4, 5, 8, 9, 10, 12, and 14 of "Understanding Key Concepts."

Compare your responses with those in the Appendix, pages 110 and 111.

Conclusion

In this section you studied the food and fibre products grown in Alberta and in the rest of Canada. You examined how farmers and foresters increase the yield of plants. You saw some of the new technologies and practices. You followed the changes in these practices and saw how they impacted the environment. You then investigated different soil types and ways to improve the soil. Finally, you examined strategies to deal with pests and the outcomes of these strategies.

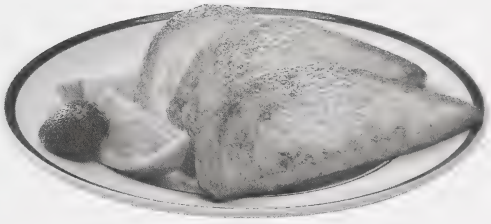
The next time you go for a ride in the country, think of the changes people have made. You may have a good idea of why changes have been made. You can appreciate the need for plant food and fibre. You know that getting food and fibre is based on harvesting the land around you.

Module Summary

In this module you examined how people depend on plants as a source of food and fibre. You saw that they meet a variety of other needs as well. You learned that people developed technologies for selecting and breeding better plant varieties. People also modified—and continue to modify—growing conditions to improve crop growth. You looked at the impacts of plant-growing technologies on the larger environment. You saw that increased plant production can have environmental costs.

Think back to the start of your day. You can probably think of many ways you used plants today.

- the food you ate
- the shampoo you used
- the clothes you wore
- the towel you dried off with
- the buildings around you
- the table you ate from



Most likely, these items came from plants. You are now well aware of the enormous human demand for plants and plant products.

The following review will help you go over and apply the work in this module. Turn to page 180 of the textbook. Carefully read and study the concepts listed in "Unit at a Glance." Complete the following "Unit 2 Review" questions on pages 180 to 183.

1. questions 1, 4, 6, 8, 10, 11, 14, and 17 of "Understanding Key Concepts"

2. questions 19 and 23 of "Developing Skills"

3. questions 25 and 29 of "Problem Solving/Applying"

4. questions 30, 34, 35, and 38 of "Critical Thinking"

Check your responses with your teacher or home instructor.

Turn to pages 7 to 13 of Assignment Booklet 2B and complete the Final Module Assignment.

Appendix

Glossary

Suggested Answers

Image Credits

Glossary

adaptation: an inherited structural or behavioural characteristic that increases a species' (or organism's) chances of surviving and reproducing in its environment

asexual reproduction: any reproductive process that does not involve the mixing of genes from two parents

Offspring are genetically identical to the parent and each other (clones). This type of reproduction is also known as vegetative reproduction.

biological controls: natural enemies, diseases, competitors, techniques, and so on used to control pests

chemical fertilizer: a manufactured supply of plant nutrients

Chemical fertilizers do not change soil structure (no humus added) or carry disease organisms or weed seeds. They provide an exact and known amount of nutrients that can be matched with the particular need.

chlorophyll: a green pigment found in plants needed for the process of photosynthesis

clay: a fine-textured, slippery soil with many mineral particles that are close together

There is very little organic matter in clay soil. Clay holds water well in its pores, but little air can penetrate.

compaction: the degree to which soil particles have been pressed (or fit) together

controlled variable (CV): a variable that is not allowed to change (remains constant) throughout the course of an investigation

cutting: a section of a plant that is removed and placed in water to allow roots to develop and a new plant to form

differentially permeable membrane: a porous (has holes) surface that lets particles pass on the basis of size

Also referred to as selectively permeable.

diffusion: the movement of particles within a fluid from higher (more particles) to lower (less particles) concentrations

diversity: variety, differences

Also, the quantity of different species living in an ecosystem. A large number of species means that there is a lot of biodiversity.

embryo: a tiny living plant found inside the seed

environmental management: balancing the wants and needs of humans with the needs of the environment

erosion: the process by which weathered rock or soil materials are carried away by water, wind, or ice

fertilizers: nutrients added to the soil to help plants grow stronger

fibre: plant tissue composed of thread-like bodies or filaments

fibrous roots: a system of short roots that can quickly soak up moisture

fuel: something that is burned to provide power or heat

gene: material found within a cell that directs what characteristics an organism will have

genetic modification: the process of directly changing the genes of an organism for a desired outcome

germinate: the development of a seed into a new plant

germination: the sprouting of the tiny plant from a seed

greenhouse: a glass structure used to grow plants in which temperature, nutrients, light, and humidity can be controlled

herb: a type of aromatic plant that can be used fresh or dried for seasoning in cooking, as a medicine, and sometimes even in perfumes

herbicide: a substance used to control or kill plant pests

humus: partially decomposed plant matter

Humus holds water in the soil and provides plants with important nutrients.

hydroponics: technique of growing plants in an artificial environment without soil

inorganic: being or composed of matter of other than plant or animal origin

insecticide: a substance used to control or kill insect pests

introduced species: a group of one type of organism that has moved into an area where they do not naturally occur

Humans have brought them in accidentally and on purpose.

irrigation: artificial water application using a system of pipes, sprinklers, and a pump

lifecycle: the stages an organism goes through from one generation to the next

The seed plant's includes three stages: seed, seedling, and adult.

loam: a soil type that does not clump together when squeezed and has a balance between organic and mineral particles

Loam absorbs water easily and contains both water and air in its pores.

manipulated variable (MV): the one variable that is purposely adjusted in an investigation to see what effect the change will have on the responding variable

mineral particles: inorganic, naturally occurring particles in soil that come from broken down rock (weathered parent material)

monoculture: artificial concentration of a single plant in an area

native grasslands: the original species of plants growing in a naturally grassy area

non-target organisms: organisms that are unintentionally affected by chemical pesticides or herbicides

organic: being or composed of matter that comes from plants or animals

organic fertilizers: natural sources of plant nutrients that come from decaying plant or animal matter, such as manure

These fertilizers improve soil structure (add humus), can carry disease organisms or weed seeds, and release nutrients slowly.

organic food: food grown without chemical pest controls or fertilizers

organic particles: small pieces of dead and decaying plant or animal matter

osmosis: diffusion of a solvent (usually water) through a selectively permeable membrane

ovule: plant structure (egg) produced by a female that develops into a seed when fertilized

parent material: mineral matter from which soil has developed

permeable: capable of allowing materials to pass through

pest: any organism that inhibits the growth and yield of a forest or agricultural crop; any organism humans find undesirable

pesticide: a substance used to control or kill pests

photosynthesis: a chemical reaction in which the Sun's energy is combined with water and carbon dioxide to produce oxygen and glucose (sugar)

pistil: the female reproductive organ of a flower that includes the stigma, style, ovary, and ovules

pollen grains: male reproductive cells produced by male cones or flowers; contains sperm

pollination: movement of pollen to the ovule of a plant

reforestation: replanting of small trees, sometimes accompanied by the application of nutrients to the soil of a logged area to speed the cycle of forest growth

residue: chemicals or the breakdown products of chemicals that remain in soil, water, air, or organisms for some period after the chemical has been applied

resistant: able to withstand something

Over time, pests can develop a resistance to pesticides, forcing the use of higher concentrations until the chemical becomes ineffective.

respiration: the process by which organisms take in oxygen and discharge carbon dioxide to satisfy their energy requirements

responding variable (RV): the variable in an experiment that is expected to change as a result of changes to the manipulated variable

rhizomes: stems that grow underground

New plants can sometimes grow off of them.

root hairs: tiny hair-like roots covering the smaller roots coming off the taproot

The root hairs are responsible for most of the plant's water and nutrient absorption.

runners: long stems that grow along the surface of the ground

New plants can sometimes reproduce from them.

salinization: a process by which salt collects as a crust on the surface layers of the soil

It is often caused by the extended use of irrigation.

sandy soil: a soil type with large mineral particles with large spaces in between them

There is very little organic material in this soil type. It is low in nutrients and water runs through its large pores

seedling: a young plant

selective breeding: a reproductive technology that involves humans selecting organisms with a desired characteristic(s) (trait) and breeding them together to produce offspring with that trait(s)

sexual reproduction: the production of unique offspring formed by the union of genetic material (e.g., egg and sperm)

soil horizon: a cross-section of soil that shows the layers

soil profile: the layers in the soil from the surface to the bedrock

stamen: male reproductive organ of a flower that includes the anther, filament, and pollen grains

stomata: tiny openings (pores) in leaves through which carbon dioxide, water, and oxygen are exchanged with the atmosphere

sustainability: the quality of being sustainable

sustainable: of, relating to, or being a method of harvesting or using natural resources so the resources are being renewed at the same rate or faster than they are being used

In a sustainable development, resources are neither used up nor permanently damaged.

taproot: a primary root that grows vertically downward and gives off small lateral roots

The taproot provides anchorage for the plant as well as access to water and nutrients deep in the soil.

topsoil: the dark-coloured, humus-rich, topmost layer of soil

transpiration: the process by which plants give off water vapour to the atmosphere; evaporation of water from leaves via the stomata (pores)

variable: any factor that could change during the course of an experiment

variety: differences

e.g., organisms of the same species that have slightly different characteristics (traits)

vegetative reproduction: the reproduction of plants where a genetically identical offspring is grown from the roots, stems, or leaves of the parent plant; a form of asexual reproduction

weathered parent material: material that provides the non-living part of the soil

It is formed from rock that has been broken down into small pieces.

xylem: a network of vascular (like blood vessels) plant tissue that transports water and minerals absorbed by the roots throughout the plant

yield: the amount of useful matter produced by a plant or group of plants

Suggested Answers

Section 1: Lesson 1

1. Plants help the environment by

   - producing oxygen
   - helping clean the air by using carbon dioxide and removing certain toxins
   - being the basis of most food webs
   - providing shelter to numerous animals
   - cleaning and filtering water
   - keeping soil in place to prevent wind and water erosion

2. Things in the picture that are made from plants are

   - root beer
   - napkins
   - French fries
   - ketchup
   - relish
   - mustard
   - T-shirt
   - wooden table

3.

Who Would Have Thought?		
Plant/Plant Part	**Food Product(s)**	**Processing Summary**
cocoa beans	chocolate	• Beans are dried, roasted, shelled, and crushed in a factory. • Powder is separated from the butter and then mixed with milk to make chocolate.
canola seeds	margarine, vegetable oil	• Oil is pressed from canola seed. • Other ingredients are added to the oil to make margarine.
seaweed	ice cream, sushi, candy	• Seaweed products are often used as a thickener.
sugar beets	sugar	• Roots are shredded and then heated in water. Liquid is then concentrated and the sugar crystallized out.

4. *Fibre* is the thread-like bodies or filaments found in plants. (The thread-like bodies or filaments themselves are called fibres.)

5. The opium poppy is the only source of the painkiller morphine.

6. Natural quinine is still effective, so it is used. In some parts of the world the synthetic quinine is no longer effective. The malaria parasite has become resistant.

7. **Textbook question 1 of "Procedure," p. 99**

Medicinal Claims	
Herb	**Claims of Effectiveness**
echinacea	This plant is used to combat colds, cough, flu viruses, and sore throats.
feverfew	This plant is considered an effective treatment for migraine headaches.
garlic	This bulb has been used to prevent infections. In World War I, the juice from this bulb was squeezed onto moss and used to dress wounds.
ginkgo biloba	This plant is one of the world's oldest living trees. It is often called the smart herb because it increases the supply of oxygen to the brain.
ginseng	This root has long been important for health in Chinese culture. It enhances mental activity and is said to stimulate the central nervous system.
aloe vera	The leaves are used to heal skin problems, such as minor burns.

8. **Textbook questions 1 and 2 of "What Did You Find Out?," p. 99**

    1. Modern medicines were often first found in plants. The herbs and these medicines have exactly the same active chemicals. They have the same effect.

    2. For the most part, herbal remedies are not controlled. (This includes their use, production, quality control, purity, strength, and labelling.) Governments may regulate them in the future.

9. Ethanol and methanol are liquid fuels that come from plants.

10. to 13. Check your responses with your teacher or home instructor.

14. and 15. Check your responses with your teacher or home instructor.

16. **Textbook questions 1, 3, and 8 of "Topic 1 Review," p. 103**

    1. Answers will vary. A sample answer is given.

    Plants for Food

    - bean dip
    - pop
    - pepper
    - sandwich (bread, lettuce, etc.)
    - cereal
    - chewing gum

    Plants for Fibre

    - wooden chair
    - loose-leaf paper
    - bicycle tires
    - pencil
    - shoelaces
    - jeans

    Both types of use are equally common.

3. Answers will vary.

   In developing countries, more wood is used for heat and cooking. It is often found close to the people living in rural areas. Other means of heating and cooking are harder to produce and deliver. The needed know-how may not be available. Less wood is used to build the generally smaller homes.

   In developed countries, more wood is used in building larger homes. More wood is used in disposable paper products, such as tissues, towels, and packaging of consumer goods. More wood is used in the production of reading materials, like books, newspapers, and periodicals.

8. Without plants, oxygen levels would fall. There would be no food for herbivores, causing their deaths. Without herbivores, carnivores would die once their source of food was gone. Without plants, water would become less and less available. Precipitation would decrease. Weather patterns would change. (Plants are responsible for moving water out of the soil and into the air through transpiration.) The carbon dioxide levels would increase, leading to global warming.

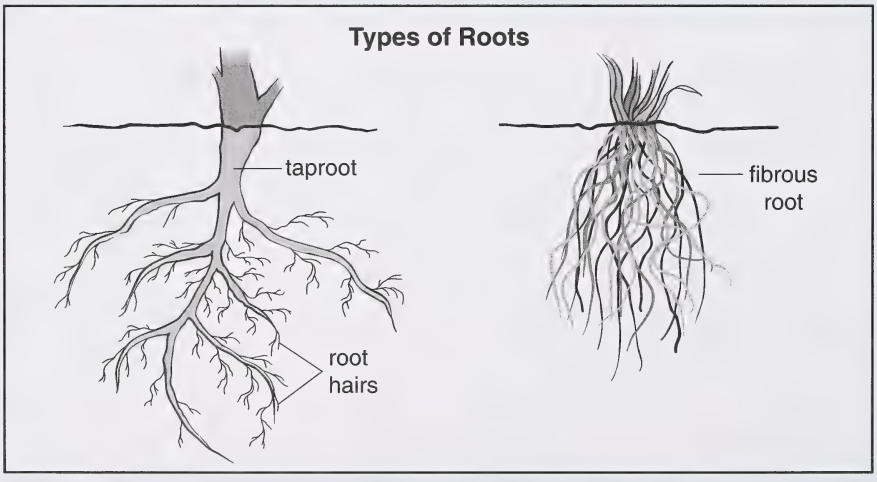
Section 1: Lesson 2

1. Check your responses with your teacher or home instructor.

2. A *taproot* is a primary root that grows vertically downward and gives off small lateral roots.

   Fibrous roots consist of a system of short roots that can quickly soak up moisture.

   Root hairs are tiny, hair-like roots that cover the smaller roots coming off the taproot.



3. Roots support and anchor the plant. They absorb water and minerals (nutrients) from the soil. They store food for times of scarcity.

4. If a plant's root hairs were destroyed or badly damaged, the plant would become unhealthy or die. The root hairs absorb most of the water and nutrients from the soil.

5. **Textbook questions 1, 2, and 3 of "What Did You Find Out?," p. 106**

    1. The food colouring moved up into the leaves. It went through a ring of tissues found around the middle of the carrot stem. Water absorbed by the root is transported upward in specific parts of the root.

    2. The major function of the carrot root is to carry water and minerals up to the leaves of the carrot. The carrot root is used for food storage. It also anchors the carrot plant in the ground.

    3. The root makes up the largest part of a mature carrot's mass. The age, room for growth, health and variety of the carrot can affect this relationship. Most leaf crops would have roots that are significantly smaller than the leaves.

6. *Diffusion* is the movement of particles within a fluid from higher concentrations (more particles) to lower concentrations (less particles).

    Being *differentially permeable* means that cells are capable of allowing materials to pass through on the basis of the size of the particles making up the materials.

    Osmosis is the diffusion of water through a selectively permeable membrane.

7. The food colouring immediately fell toward the bottom of the water. It spread slightly as it fell. Over the 5-minute period, it slowly spread out. The colour became uniform throughout the glass. This process is known as diffusion. The particles of food colouring moved. They left an area of high concentration (lots of particles) and went to areas of lower concentration. Finally, they were evenly dispersed.

8. The celery is wilted in Figure 2.17B because water is evaporating from the leaves and is not being replaced.

9. Stems have three main functions:

    - They transport water and nutrients between the roots and the leaves. This occurs by tubes in the stem, called **xylem**. Xylem can be thought of as a bunch of straws.

    - They support the leaves and the rest of the plant. You can think of it like the backbone of the plant. They make sure the plant grows tall enough to get enough light, which is needed in photosynthesis.

    - They store food made from photosynthesis. When you eat a potato, you are eating part of a stem known as a tuber. This stem has stored its food in the form of starch. Other stems, like sugar canes, store the food in the form of sugar.

10. **Textbook questions 1, 2, and 3 of "What Did You Find Out?," p. 108**

    1. The coloured tubes in the celery are xylem. They are specialized tissue in the stems. They move water and nutrients upward to the leaves.

    2. A freshly cut stalk was used. This ensured that the cells of the celery contacting the coloured water were fresh and undamaged.

    3. If the stalk was bent, the coloured water would not have made it past that point. The xylem would have been damaged (squeezed or broken) at that bend.

11. Answers will vary. You may know that plants do not photosynthesize in the dark. You may not know that much of the water the plant moves up from the roots is for photosynthesis. You will soon learn that the guard cells around the stomata (leaf pores) close in the dark. This prevents unnecessary loss of water at night. Thus, the coloured water would not have moved very far up the stem.

12. *Chlorophyll* is a green pigment found in plants.

    Photosynthesis is the chemical reaction by which green plants transform light energy into chemical energy.

    Respiration is the process by which organisms take up oxygen and discharge carbon dioxide to satisfy their energy requirements.

    Transpiration is a plant's loss of water, mainly through the stomata of its leaves.

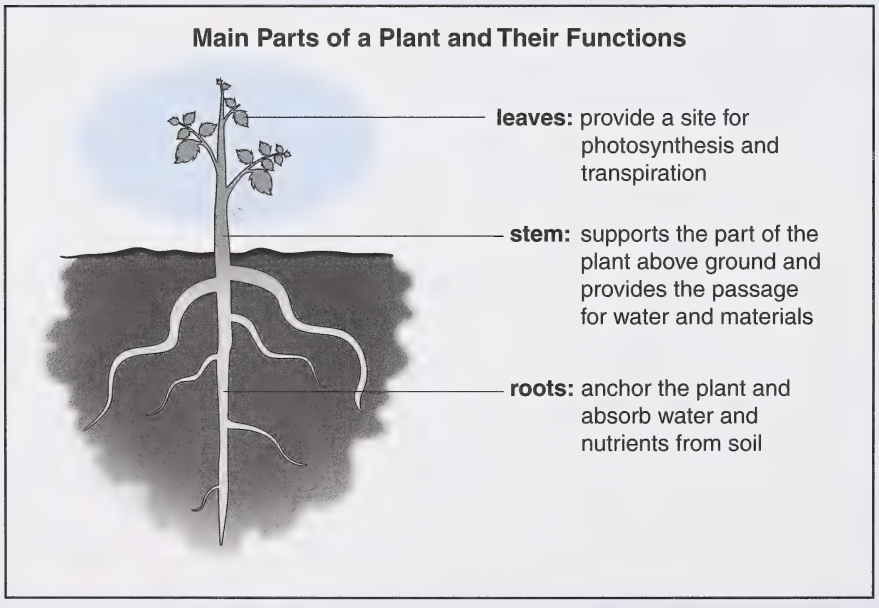
13. **Textbook question "Pause and Reflect," p. 110**

    Once the green pigment (chlorophyll) is lost, photosynthesis can no longer take place. Therefore, the leaves die and fall off.

14. The condensation in the plastic bag could be evidence of transpiration.

15. **Textbook questions 1, 2, 4, 5, 6, and 7 of "Topic 2 Review," p. 114**

    1.


Main Parts of a Plant and Their Functions
leaves: provide a site for photosynthesis and transpiration
stem: supports the part of the plant above ground and provides the passage for water and materials
roots: anchor the plant and absorb water and nutrients from soil

    2. Osmosis is the diffusion of water through a semi-permeable membrane. The water comes from an area of plenty and goes to an area where there is less. Osmosis continues until the amount is the same everywhere. The process of osmosis explains the movement of water into the root hairs of a plant.

4. a. Xylem and phloem are tube-like stem tissues. They are responsible for distributing materials throughout the plant. Xylem moves water and nutrients up. Phloem moves sugar down.

   b. Osmosis is the diffusion of water through a semi-permeable membrane. Diffusion occurs when particles move from an area of higher concentration to an area of lower concentration. It continues until the substance is distributed equally throughout.

   c. Chlorophyll is the green pigment. It absorbs the light energy needed for the process of photosynthesis. Photosynthesis combines water and carbon dioxide. The result is food for the plant.

   d. Some underground crops are actually swollen stems. These are called tubers (e.g., potatoes, dahlias). Most root crops are taproots (e.g., carrots, parsnips, radishes).

5. Stomata are pores (openings) in the lower surface of leaves. These pores are surrounded by two guard cells. They control the size of the pores. The stomata allow the leaves to exchange gases with the atmosphere. Carbon dioxide enters and water and oxygen leave through these pores.

6. Answers will vary. Sample answers are given.

   - roots: beets and carrots
   - stems: potatoes and rhubarb
   - leaves: lettuce and spinach
   - seeds: wheat and corn
   - fruit: apples and tomatoes

7. Like the cactus, the leaves of a northern evergreen tree have been modified to conserve water. The slender needles have a tough waxy surface that also decreases water loss. The dry, stringy texture of the needles and strong taste discourage animals from eating them. This also provides resistance to late or early cold snaps. Keeping their needles year round conserves energy and nutrients. They don't have to regrow leaves each year. It also allows the trees to survive short growing seasons. There is no time wasted growing new leaves. Some evergreens release a toxin into the soil. It reduces competition for scarce resources (water and nutrients). The toxin stops other plants from growing near it.

Section 1: Lesson 3

1. A *trait* is any observable characteristic of an organism.

   Selective breeding is a process of sexual propogation using specific plants with desired traits

2. Answers will vary. A sample answer is given.

   A *desirable trait* is a characteristic or feature that meets a human want or need. Humans selectively breed organisms to get these traits.

3. A *gene* is a unit of hereditary information within a cell that directs what characteristics an organism will develop.

   Genetic modification (or engineering) is the process of directly changing the genes of an organism for a desired outcome.

4. a. Trembling aspens reproduce vegetatively. They grow new, genetically identical plants from their roots.

   b. Trembling aspens can be identified as belonging to the same clone by looking at the leaves in the fall. They will all turn colour at exactly the same time.

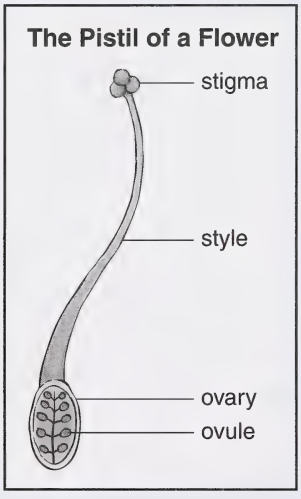
5. Grafting is a form of vegetative reproduction. A branch from one tree is attached to the stem of another tree. The branch grows and produces fruits or flowers that have desirable characteristics.

6. All navel oranges are grown on grafts from navel orange branches. All grafts originate with a single tree in Brazil.

7. An *ovule* is part of the female reproductive organ of a plant. It develops into a seed when fertilized.

   Pollination is the movement of pollen to the ovule of a plant.

8. When eating a kernel of corn, you are eating a seed that has been fertilized.

9. 

10. In self-pollination, the male sperm fertilizes the female eggs of the same plant. In cross-pollination, pollen from one plant is carried to the stigma of another plant. Wind, water, or animals may carry it.

11. Artificial pollination might be useful to breed plants for specific purposes. Growers can get seeds for desired plants this way. They will control when and where the seeds grow.

12. The embryo is made up of a leaf, stem, and tiny root.

13. The cotyledon is very important because it contains stored food. The embryo needs this to survive. (It cannot carry out photosynthesis in its initial stages of growth.)

14. a. The growing ovary that protects a seed is called a fruit.

    b. Tomatoes and zucchini are classified as fruits.

    c. The seeds are protected in a swollen ovary.

15. **Textbook questions 1 and 2 of "What Did You Find Out?," p. 125**

    1. The plant's food takes up much more space. This is because the plant is not able to make its own food until it has green leaves. It must use the stored food (usually starch formed from sugar) to survive.

    2. Water causes the seed to swell and increase in size. Water softens the seed coat, stimulates growth, and helps change the stored food into a form more easily used by the embryo.

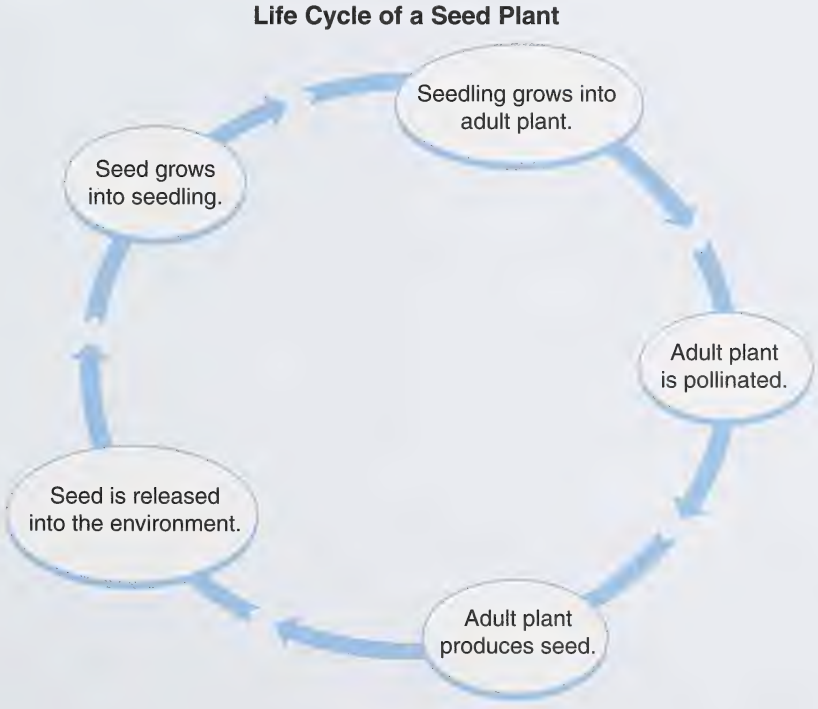
16. Growers manipulate the grape plant's hormones. They want to minimize the growth of the seeds. As a result, the seeds do not grow to a noticeable size. Yet, the fruit grows around them. Another example of a plant where growers manipulate the plant's hormones is the watermelon. This leads to the seedless watermelon. Navel oranges result from a genetic mutation in a single tree. The flowers of that tree did not produce seeds even though they still produced fruit.

17. The swather cuts the plant and the seeds are left to ripen and dry. A combine then separates the grain from the rest of the plant.

18. a. The plant parts shown are root hairs.

    b. It is important that root hairs grow early in a seedling's development. They absorb water and nutrients from the soil.

19. a. Answers will vary. A sample concept map is given.


Life Cycle of a Seed Plant
Seedling grows into adult plant.
Adult plant is pollinated.
Adult plant produces seed.
Seed is released into the environment.
Seed grows into seedling.

b. **Textbook questions 1 and 2 of "What Did You Find Out?," p. 130**

1. Answers will vary. Sample situations are given.

   - A seed might not get released from the ovary.
   - A seed may not get dispersed to an area where it can grow.
   - Temperature, soil, water, or nutrient conditions may not be right for germination.
   - A young plant could get destroyed by animals, humans, or environmental conditions (such as frost and drought).
   - An adult plant may not get pollinated due to many factors, such as a lack of pollinators.
   - An adult plant could contract a disease that does not allow it to reproduce.

2. People (especially farmers) could do the following to ensure a plant's lifecycle can be completed:

   - provide pollinators, such as bees
   - regularly water soil and add nutrients
   - ensure there are few, if any, pests
   - plant seeds sufficient distances apart so little competition for light, space, and nutrients takes place

20. **Textbook questions 1 to 4 of "Topic 3 Review," p. 130**

1. Vegetative reproduction techniques include grafting, cuttings, layering, and using bulbs or tubers.

2. Keeping bees can help a farmer. Bees will increase the rate of pollination of plants with flowers. More seeds will be formed.

3. Answers will vary. A sample answer is given.

   Plants may have trouble being pollinated. The nutrient content of the soil may be a problem. Growers can provide bees. They could put populated hives nearby. They could fertilize the soil to add needed nutrients.

4. Desirable characteristics of apple varieties could include size, sweet taste, small core, thin skin, and a firm texture. Undesirable traits could include soft and mushy texture, bitter taste, bruises and blemishes, and dull colour.

   You would choose and selectively breed for the desirable apple traits. You might also choose to genetically engineer apples to directly combine or change traits.

   A research question could be, "How does the thickness of the skin affect the number of blemishes apples get?" or "What effect does the texture of the apple have on the ease with which it bruises?"

Section 1 Review

1. to 4. Check your answers with your teacher or home instructor.

Section 2: Lesson 1

1. Scientists are trying to understand how natural systems work. Scientists, farmers, and foresters are developing practices. These practices have a less negative impact on the environment.

2. Over 20 million hectares are now managed as farmland.

3. A monoculture is the growing of a single plant variety in a whole field.

4.

Common Alberta Monocultures		
Crop Type	**Region of Province Monoculture Is Found**	**Uses/Interesting Facts**
Barley	**grown throughout the province (especially in drier areas)**	This is fed to livestock and used to make malt for beverages, such as beer.
Canola	all over province	This is the second most valuable Alberta crop. The oil is pressed out of seed.
Oats	along forests in northern and western regions	Oats are grown to feed livestock and are adapted to cool, moist areas.
Wheat	southern portion of province	One third of the world's population grinds wheat for flour.
Legumes	Parkland and Peace River regions	These are high-protein crops. They include field peas, beans, and lentils.
Potatoes	much of Alberta	Half of the potatoes grown are used for frozen fries or potato chips.
Alfalfa	all over Alberta	Alfalfa is grown for leaves and stems, fed to livestock, and has large taproots.
Specialty Crops	southern Alberta	These crops need warm, moist areas. They include crops like sunflowers, beans, corn, sugar beets, lentils, and spices.

5. Plant breeders have developed a new variety of corn. It grows very well in central Alberta because it can be grown with less heat. The climate of central Alberta is not always warm and stable. This variety is perfect for this variable environment.

6. Check your response with your teacher or home instructor.

7. A greenhouse is an artificial growing environment. It is usually enclosed by glass. Warmth, light, soil nutrients, and moisture can all be controlled in a greenhouse.

8. Check your response with your teacher or home instructor.

9. Check your responses with your teacher or home instructor.

10. *Irrigation* is a system of pipes, sprinklers, and a pump used to supply water to crops artificially.

    Erosion is the process of carrying away weathered rock and soil materials by water, wind, or ice.

11. a. Large machinery can be used on the crop. Also, all of the plants in the crop have the same requirements and growth pattern.

    b. Monocultures are very attractive to pests. Lots of the same type of plant is available in a small area. Micro-organisms and disease can easily pass from plant to plant. Monocultures lack diversity. For the most part, only one type of organism grows there.

12. Irrigation provides water to plants. Water is essential for photosynthesis.

13. **Textbook questions 1, 2, and 3 of "What Did You Find Out?," p. 142**

    1. At the start, the soil content should have been the same in all trays. The soil that was covered with organic material probably retained water the best. The soil with organic material mixed in was likely second.

    2. Using organic material helped maintain the moisture level of the soil.

    3. Squeezing soil can be used to indicate moisture level. Moist soil tends to clump together better than dry soil. Colour can be used as an indicator. Wet soils are usually darker. The easier it is to blow away, the drier it is. You can buy a water meter to get a precise measurement of soil moisture.

14. *Environmental management* is the science of balancing the wants and needs of humans with the needs of the environment.

    Diversity means variety. In this case, it refers to the variety of species living in an ecosystem.

15.

Species of Tree	Description
aspen	good for wood panel products and often used for pulp and paper
white birch	heavy, strong wood used for firewood and making furniture
black spruce	light, strong wood used for lumber and pulp; makes strong paper
white spruce	takes over from aspen and pine trees as a forest matures; used for lumber and plywood
lodgepole pine	highly valued, strong wood used historically to build shelters and the railway
tamarack	resists fungi, making it useful for fence posts and railway ties

16. Check your responses with your teacher or home instructor.

17. Here are some examples of global problems that are currently decreasing environmental health, diversity, and sustainability.

    - the droughts that have led to desertification in North Africa
    - vegetation that has been removed in Brazil and West Africa, leading to useless soil for crops
    - chemicals used in agriculture polluting the waterways in Europe and USA
    - salinization (salt buildup because of too much irrigation) in Pakistan

18. **Textbook questions 1, 2, and 3 of "Topic 4 Review," p. 148**

    1. Answers will vary. Plants grown for food in Alberta are wheat, oats, canola, barley, legumes, alfalfa, potatoes, and some specialty crops (such as beans, corn, sugar beets, lentils, and spices). Plants grown for fibre in Alberta are lodgepole pine, white and black spruce, aspen, white birch, and larch trees.

    2. Sustainability means being able to continue to grow healthy plants for food and fibre. It also requires that the natural environment or living resources (forests and soils) aren't seriously damaged.

    3. Answers will vary. Some examples of modern technology used to help grow or harvest plants are irrigation, adding fertilizers, growing crops in a monoculture, greenhouses, row covers, using pesticides, and techniques for harvesting trees (such as felling, skidding, and scarification). The techniques used in reforestation also use modern technology.

Section 2: Lesson 2

1. *Inorganic material* is material that is composed of matter of other than plant or animal origin.

   Organic material is material that is composed of matter that comes from plants or animals.

   Parent material is the mineral matter from which soil has developed.

   Humus is partially decomposed plant matter.

2. A *soil horizon* is a cross-section of soil showing the layers.

   Topsoil is the dark, topmost layer of soil in a soil horizon.

3. a. The topsoil would be loam.

   b. This soil is probably clay—little humus, holds lots of water but little air, bluish tinge, and likely very fine-grained.

   c. Sandy soil has the coarsest particles or grains.

4. Earthworms in one hectare of soil can process 30 tonnes of matter in one year.

5. Check your responses with your teacher or home instructor.

6. An *organic fertilizer* is a natural source of plant nutrients that come from decaying plant (or animal) matter. Manure is an example of an organic fertilizer.

   A *chemical fertilizer* is a manufactured source of plant nutrients.

7. A plant's need for nutrients varies through its growth cycle. For example, nutrients are required in different amounts when growing leaves versus roots versus flowers and seeds.

8. *Salinization* is the process by which salt collects on the surface of soils.

9. a. Too little vegetation can lead to salinization. This is because there are too few plants to absorb the water and return it to the atmosphere. It moves through the soil as ground water instead. The second factor that leads to salinization is too much irrigation. When there is excess ground water, it dissolves the salt in the soil. The irrigation water also contains salts, which it leaves behind in the soil.

   b. To prevent salinization, there must be enough plants to use up the water. Growers must watch irrigation closely so only enough water is added to the soil. Irrigation canals can be lined to prevent water from seeping into the ground water.

10. Humus contain nutrients and holds water. This decreases the amount and speed of run-off. It also adds bulk to the soil and holds it together. This decreases wind and water erosion.

11. Carbon is held both in vegetation and in humus. When vegetation is eliminated, the amount of humus also decreases. The amount of carbon released in the form of carbon dioxide increases. The buildup of carbon dioxide in the atmosphere can add to global warming. Wise farming practices can keep the carbon in the soil and plants. This will keep excess carbon dioxide out of the atmosphere.

12. Shelterbelts limit erosion by slowing wind and water. They also trap snow, retaining water for the next crop. They act as habitats for wildlife and useful organisms, such as pollinators.

13. *Hydroponics* is a technique of growing plants in an artificial environment without soil.

14. Pests are easier to control in a greenhouse environment, making them less of a problem than they are in a field.

15. To limit erosion in harvested areas, tree parts are left to shelter the soil, absorb and slow water, and add organic nutrients as they decay. Reforestation should take place soon after logging. Trees should not be cut in a wide band along streams and gullies and other water bodies.

16. **Textbook questions 1 to 6 of "Topic 5 Review," p. 162**

    1. The five major factors that affect soil development are as follows:

        - the amount and type of parent material
        - the vegetation, which affects the type of organic material
        - the landscape, which affects the amount of water in the soil, the speed of water run-off, and the temperature of the soil
        - the climate, which determines what types of plants will grow and how fast they will become humus
        - time (Soils change and develop over time.)

    2. Examples of organisms that live in the soil are as follows:

        - worms and other burrowing animals that add air space to the soil and help to decompose organic matter
        - bacteria and fungi that help to break down organic matter and help plants absorb water and nutrients
        - small insects that break down organic waste and add air space to soil by moving around in it and breaking it up

    3. Soil that develops under grasslands has a large amount of organic matter in the topsoil. This is because the soil is almost completely covered with grasses that have a yearly lifecycle. Grass blades grow and die every year, producing a lot of humus. Lots of humus means lots of nutrients and good water retention. Fibrous grass roots hold the soil together. Soil that develops under forest vegetation does not have as much organic matter in the top layer. Roots tend to be bigger and go deep down into the soil. Most of the vegetation is found on the surface of the soil and is decomposed there by fungi. There is often less ground cover due to limited light on the forest floor. Less light also means that soil and air temperatures are cooler and the air is often moister. This would slow the breakdown of organic materials.

    4. Organic matter adds important nutrients to soil. It gives the roots a place to anchor. It absorbs and slows the movement of water. It adds bulk and holds soils together to decrease erosion.

5. Practices in farming and forestry that help to limit erosion or improve soil health include the following:

   - use of organic fertilizers
   - zero-tillage farming
   - wide-shovel cultivation
   - shelterbelts
   - seeding run-off water channels
   - managing irrigation carefully
   - crop rotation
   - leaving plant parts on harvested areas
   - not cutting trees on steep slopes
   - leaving a band of trees (buffers) along water bodies
   - replanting forests quickly

6. The three major nutrients in fertilizers are nitrogen, potassium, and phosphorus.

Section 2: Lesson 3

1. The grasshopper is considered a pest because it eats the plants that humans grow for food or fibre. If it ate other plants humans did not want, it would most likely not be considered a pest.

2. Monocultures are excellent places for pests to live. There is so much food that is easy to get. It is in a highly concentrated and uninterrupted area, making eating easy.

3. Insects and diseases consume over 50% of Canada's annual harvest.

4. and 5. Check your responses with your teacher or home instructor.

6. Dandelions have become an effective pest because of the following:

   - **powerful roots:** Dandelions have a long taproot. This helps it survive in dry conditions. When pulled, the part of the root often remains in the ground and a new plant can grow from it quickly.

   - **broad leaves:** Dandelions have leaves with lots of surface area for photosynthesis. Also, the shade created by these leaves kills many competitors.

   - **super seeds:** Dandelion flowers produce hundreds of seeds. They can be dispersed great distances by the slightest wind.

   - **adaptable:** Dandelions have a wide range. They tolerate varying heat, light, soil, and moisture conditions. They can live and reproduce in a wide variety of situations. They grow very rapidly, so they can outcompete slower-spreading or growing plants.

   - **chemical weapons:** Dandelions release toxic chemicals. These slow the growth or kill other plants around them. As a result, there is more light, nutrients, moisture, and space for the dandelions.

7. Scientists have developed canola plants that are resistant to most herbicides.

8. Quack grass, thistles, chickweed, and dandelions are all examples of plant species that have been introduced to Canada.

9. The cane toad was introduced to Australia as a biological control. It was to control pests in sugar cane fields. With no natural controls, they have spread and become pests.

10. Techniques used to control pests are as follows:

    - chasing or scaring away pests
    - picking weeds by hand
    - ploughing or cultivating the top layer of soil
    - crop rotation (growing a different crop in a field each year)
    - regular summer fallow
    - using chemicals (herbicides and/or insecticides)

11. and 12. Check your responses with your teacher or home instructor.

13. *Resistant* means to be able to withstand something. Over time, pests can develop a resistance to pesticides, forcing the use of higher concentrations.

14. Check your response with your teacher or home instructor.

15. Many people do pay the extra price for organically grown foods. They feel their health and the health of the environment is worth it.

16. **Textbook questions 1 to 4 of "Topic 6 Review," p. 174**

    1. The three kinds of pests are plants, animals, and diseases. Often, other plant pests are called weeds. Insects are among the animal pests. Diseases are usually in the form of a fungus or bacteria. There are many examples of each kind. Canada thistle and wild oats are weeds that lower canola yields. Blackleg fungus and fusarium fungus are diseases that harm canola. Lygus bugs and bertha army worms are insects that can also harm canola.

    2. Non-native pests are hard to control. There are no natural controls. (Their predators, competitors, and disease have been left behind.) Their new environment is just a wonderful place to grow and prosper.

    3. Answers will vary. A sample answer is given.

       The ultimate weed would tolerate a wide range of conditions. It would be happy with pretty much any temperature. Moisture, nutrients, and soil type wouldn't matter. Their seeds would need to be easily dispersed by wind. They would be very fast growing. The would have lots of leaf surface for photosynthesis. It would help to have a large root system to absorb water and nutrients. It would also provide a strong anchor against wind and water erosion. It should reproduce asexually as well as sexually. Runners or rhizomes increase the survival rate of new plants. It would be resistant to herbicides. The weed would release a toxic chemical that could kill other plants around it. The toxin would make its leaves taste so bad that other organisms would not eat them. It would be pollinated by wind. (Insect populations would not have an effect on them.)

    4. To control dandelions organically, a biological control could be used. For example, insects could be released that enjoy dandelions as food. The dandelions could be hoed, cultivated, and dug out as deep as possible. They need to be removed before they produce seed. Don't give them a chance to grow very large and affect other plants.

Section 2 Review

1. **Textbook question 2 of "Reviewing Key Terms," p. 175**

2. a. A monoculture has little diversity. A monoculture is only one species in a given environment. Diversity occurs when there are a large number of species within an environment.

   b. Irrigation water can dissolve salts and other minerals in the soil. When the water evaporates, the salts are left behind. This is called salinization.

   c. Erosion causes the washing or blowing away of topsoil. Overploughing land and clearing land of plants can speed up erosion.

2. **Textbook questions 4, 5, 8, 9, 10, 12, and 14 of "Understanding Key Concepts," p. 175**

4. Sustainability relates to continuous use of resources. (Resources are not used up or depleted.) It needs the use of proper management techniques. They allow forests and farmland to be used for similar purposes for years to come.

5. Climate and soil type determine many of the techniques a farmer will choose to benefit crop growth. Climate and soil type also affect what a farmer can do to keep a healthy environment. For example, if the soil holds water well, the farmer would not want to irrigate too much. It could cause erosion or salinization to take place. The climate and soil types also affect how much fertilizer should be used. They also affect the type of crops that grow the best.

8. Summer fallow is the practice of leaving farmland without a crop for a growing season. It includes removing weeds as they grow in this area. The idea is that it lets nutrients build up and eliminates weeds. This practice can damage the soil. There can be more erosion from wind and water. Valuable topsoil containing organic matter could be blown or washed away.

9. You can save soil moisture in several ways:

   - Increase the organic content in the soil as it absorbs water.
   - Use zero-tillage techniques.
   - Leave a "trash cover" on the top of the soil that will absorb moisture.

10. The amount of organic matter affects a plants ability to grow. It adds necessary nutrients to the soil as well as absorbs moisture. There needs to be sufficient moisture in the soil. Plants absorb it through osmosis for use in photosynthesis. If there is too much water, however, and not enough air, the plants can literally drown.

12. There are numbers on fertilizer bags. The numbers explain the nutrient content in the bag. The three nutrients usually listed are nitrogen, phosphorus, and potassium. The numbers are percentages. The first number tells what percent of the content is usable nitrogen. The second number gives the percentage of phosphorus. The third gives the percentage of potassium.

14. There are farming practices that can reduce the need for chemical pesticides. Here are some examples:

- You can use biological controls.
- You can use crop rotation.
- You can use cultivation methods that remove weeds but avert erosion.

Module Summary

1. to 4. Check your responses with your teacher or home instructor.

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